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ABSTRACT

This study examined the occupational stability of bachelor's degree recipients during the first 4 years after receiving the degree, analyzing whether those who were teaching in 1994 were more or less likely than those in other occupations to leave the work force for work in different occupations in 1997. Data came from the Baccalaureate and Beyond Longitudinal Study, which surveyed bachelor's degree recipients in 1992-92, 1994, and 1997. Data analysis indicated that among graduates who were employed in 1994 and 1997, K-12 teachers (i.e., graduates who taught in 1994) were as likely as graduates who worked in other white collar, professional occupations to work in the same occupation category in 1997. Approximately four-fifths of graduates who taught in 1994 were also teaching in 1997, and similar proportions of graduates who worked in other occupations worked in their respective occupation categories in both 1994 and 1997. Graduates who worked in other occupation categories in 1994 were less likely than K-12 teachers to work in the same occupation category at both points in time. This occurred despite the fact that teachers were held to a higher standard. A glossary of terms and technical notes and methodology are appended. (Contains 24 references.) (SM)

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Attrition of New Teachers Among Recent College Graduates

Comparing Occupational Stability Among 1992–93 Graduates Who Taught and Those Who Worked in Other Occupations

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Statistical Analysis Report May 2001

Postsecondary Education Descriptive Analysis Reports

Attrition of New Teachers Among Recent College Graduates

Comparing Occupational Stability Among 1992–93 Graduates Who Taught and Those Who Worked in Other Occupations

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Executive Summary

News reports frequently discuss the shortage of elementary/secondary teachers in the United States. Increasing enrollments, particularly in the elementary grades; increasing rates of retirement among teachers; and the efforts of states and localities to reduce class size may well have contributed to many of these shortages (Johnson 2001). In recent years, enrollments in public and private elementary and secondary schools have grown considerably, and most expect that they will continue to climb through 2005, after which they are expected to drop slightly through 2010 (Gerald and Hussar 2000). Nevertheless, shortages may well continue since the proportion of teachers who retire each year is expected to rise (Goodnough 2000). As experienced baby-boomer teachers retire, they are likely to be replaced by young and inexperienced teachers, whose attrition rates are higher than those of mid-career teachers (Archer 1999; Grissmer and Kirby 1997).[1]

Many researchers and policymakers attribute the higher attrition rate among new teachers to their working conditions (e.g., Baker and Smith 1997). Therefore, to encourage new teachers to remain in the profession, many states and localities have launched programs to support them (Archer 1999; Cooperman 2000). Policy analysts have also recommended that schools and districts professionalize teaching to improve retention (Kanstoroom and Finn 1999; Holmes Group 1986; National Commission on Teaching and America's Future (NCTAF) 1996, 1997).

Such policy initiatives may help new teachers become better teachers more quickly and may increase occupation stability among all teachers; however, they do not address other possible reasons for attrition among new teachers. Although such attrition has received considerable research attention over the years (Darling-Hammond 1984; Murnane et al. 1991), whether new teachers are more likely than college graduates beginning careers in other professions to change occupations has not yet been addressed. High attrition from initial occupations may be endemic to new college graduates' entry into the labor market, regardless of occupation, as new graduates learn about the workplace and about their strengths and weaknesses as well as what they like and dislike about their jobs. In addition, interest or aptitude for a field in an academic setting may not always translate into satisfaction in a related occupation. Particularly among graduates who majored in academic, rather than applied, fields of study, information about the kinds of work available to them and their affinity for it may be limited. If new college graduates change occupations at similar rates regardless of their early occupations, reducing attrition among new teachers may be as much a matter of helping college students and new graduates choose, plan, and prepare for their careers as supporting new teachers and professionalizing teaching.

[1]Schools and Staffing Survey (SASS) data from 1994–95 indicate that about 8 percent of teachers who had taught less than 4 years left the profession since the previous school year, and that about 7 percent of teachers with 4 to 9 years of experience did so (Whitener et al. 1997). In contrast, between 4 and 5 percent of teachers with 10 to 24 years of experience left between 1993–94 and 1994–95. Other SASS estimates indicate that approximately 30 percent of new teachers leave the profession within the first 5 years of entry (Ingersoll as cited in Archer 1999).

This research examines the occupation stability of bachelor's degree recipients during the first 4 years after receiving the bachelor's degree. The analyses address the following question: were graduates who were teaching in 1994 more or less likely than those in other occupations to leave the work force or work in a different occupation in 1997?

Data and Methodology

The 1993 Baccalaureate and Beyond Longitudinal Study (B&B:93) provided the data for these analyses. NCES first surveyed a nationally representative sample of about 11,200 students who received bachelor's degrees between July 1, 1992 and June 30, 1993 in the spring of 1993, and then again in 1994 and 1997. These analyses are based on the 83 percent of the original sample, about 9,300 graduates, who participated in all three B&B survey administrations.

The B&B data provide an important opportunity to compare the behavior of a significant proportion of new teachers to that of their nonteaching peers. However, results from these analyses cannot be generalized to all new teachers in 1994 or 1997 because many new teachers do not begin teaching immediately after completing a bachelor's degree.

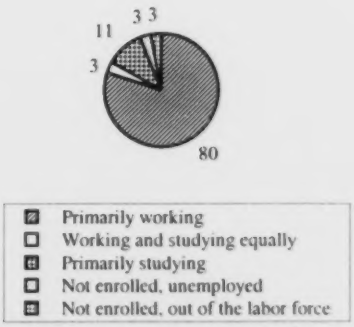
These analyses are based largely on composite variables developed from graduates' reports of what they were doing during both April 1994 and 1997. Composites were created to summarize graduates' major activities (e.g., working, studying, or both) in 1994 and 1997, whether their major activities differed between April 1994 and April 1997, and whether their occupations differed between the two years.

Results

Teaching and Teacher Attrition Among 1992–93 Bachelor's Degree Recipients

In April 1994, 80 percent of 1992–93 graduates were primarily working,[2] and another 3 percent combined study and work equally. The remaining graduates were primarily studying (11 percent), were not enrolled and either unemployed (3 percent) or were out of the labor force (3 percent) (figure A). Kindergarten through 12th-grade teachers made up 10 percent of graduates who were working full time in April 1994 (figure B).

Figure A—Percentage distribution of 1992–93 bachelor's degree recipients according to main activity: April 1994



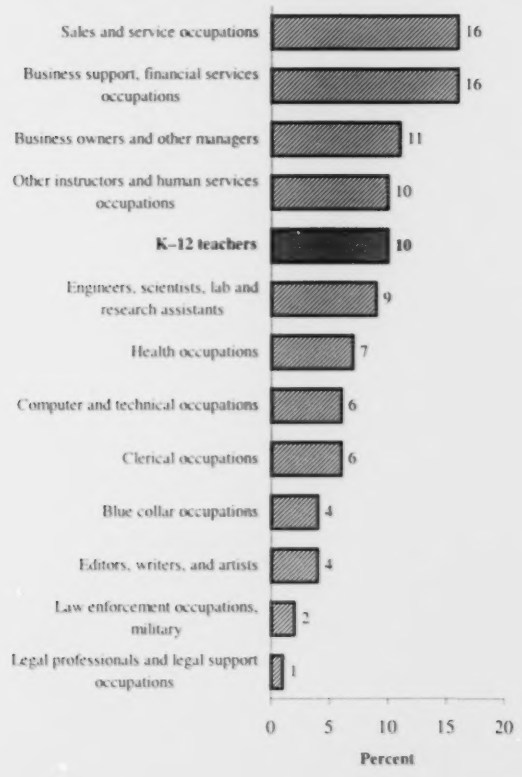
NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

Whether they were employed full time or part time in April 1994, most graduates who worked as K–12 teachers in April 1994 were also employed

[2]Graduates who were primarily working were working for pay full time or part time, but they were working more than they were studying. This category includes graduates who were working full time and either not enrolled or enrolled part time and graduates who were working part time and not enrolled.

Figure B—Percentage distribution of 1992–93 bachelor's degree recipients who were employed full time according to occupation: April 1994



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SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

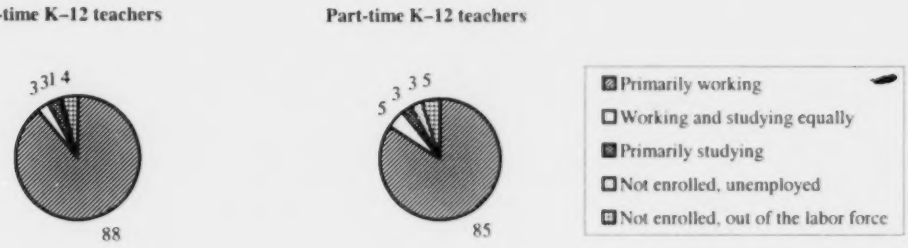
in April 1997. Among those employed full time as K–12 teachers in April 1994, 88 percent were primarily working, 3 percent were working and studying equal amounts, and 3 percent were primarily studying in April 1997 (figure C). Among those employed part time as K–12 teachers in April 1994, 85 percent were primarily working, 5 percent were working and studying equal amounts, and 3 percent were primarily studying in April 1997.

Among those who were employed as full-time K–12 teachers in April 1994 and who also worked in April 1997, 82 percent were still teaching in April 1997 (figure D). Furthermore, none of the other occupation categories proved more stable than teachers. In particular, K–12 teachers were as likely as those who worked in health occupations; engineers, scientists, and lab and research assistants; and several other white collar occupation categories to work in the same occupation category in both 1994 and 1997.

Somewhat fewer of those who were working part time remained in teaching. Among April 1994 part-time K–12 teachers who worked in April 1997, 67 percent worked as K–12 teachers in April 1997. Nevertheless, among graduates who worked in April 1997, graduates who worked part time in April 1994 as K–12 teachers were more likely than those who worked part time as computer or technical workers, sales/service representatives, blue-collar workers, business owners or other managers, or clerical workers to work in the same occupation in April 1997. In other words, part-time K–12 teachers were as likely as graduates who worked part time in the remaining occupations to work in the same occupation in both time periods.

In addition to perceptions that the overall new teacher attrition rate is high, policymakers and researchers fear that, among teachers, those who major in fields other than education, particularly mathematics and the natural sciences, are more likely than education majors to leave the profession. The B&B:93/97 data indicate that among those who were primarily working in April 1994, there were no differences between teachers with majors in education and those with majors in engineering, mathematics, or the natural sciences in the proportion who were primarily working in April 1997. However, among K–12 teachers in

Figure C—Percentage distribution of 1992–93 bachelor's degree recipients who were employed as K–12 teachers in April 1994 according to main activity in April 1997, by April 1994 employment status



NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

April 1994 who were working in April 1997, 70 percent of those who had majored in engineering, mathematics, or the natural sciences were teaching at the K–12 level in April 1997, compared with 86 percent of education majors.

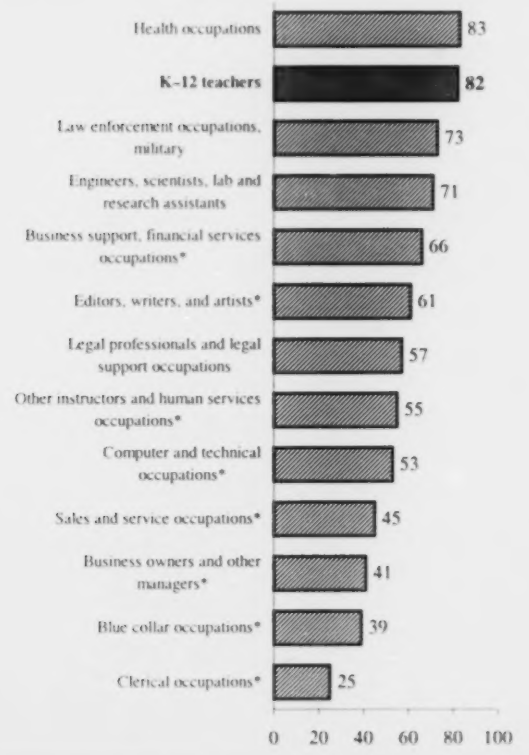
Thus, this analysis indicates that among 1992–93 college graduates who worked in April 1994, approximately a year after they had completed their bachelor's degrees, those who taught at the K–12 level were among the most stable of all employed graduates with respect to their occupations 3 years later. Relatively few teaching graduates had different main activities or different occupations in April 1997 than they did in April 1994. Graduates who worked in other occupations for which employees train as undergraduates (e.g., engineering and health occupations) also had relatively low rates of attrition. Moreover, these occupations also tended to have higher professional status than the occupations in which graduates were more likely to change occupations between 1994 and 1997. Therefore, this report also examines whether two additional variables—graduates' perceptions of the relationship between their postsecondary fields of study and occupations and their views about the professional status of their occupations—vary with occupations and are associated with changing occupations between April 1994 and April 1997.

Relationship Between April Occupations and Postsecondary Fields of Study

Among those working as K–12 teachers in April 1994, nearly all reported that their jobs were related to the field they studied as undergraduates (97 percent among full-time teachers and 96 percent among part-time teachers). Similarly, among graduates who were working full time in April 1997, 93 percent of K–12 teachers reported that their jobs were somewhat or closely related to their graduate or undergraduate field of study. In both 1994 and 1997, the proportions of graduates employed full time in a health occupation or as engineers, scientists, or lab/research assistants who indicated that their jobs were related to their undergraduate major were similar to those of teachers.

Graduates who worked in many other occupations, however, were considerably less likely to

Figure D—Among 1992–93 bachelor's degree recipients who worked full time in April 1994, percentage who worked in the same occupation category in April 1997, by April 1994 occupation



*Statistically significantly different from K–12 teachers at the .05 level

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

report that their jobs were related to their undergraduate majors. In April 1994, graduates who worked in clerical, blue-collar, or sales/service occupations or as business owners or other managers were less likely than teachers to report that their jobs were related to their undergraduate majors: 72 percent or less of graduates in these occupations did so. Furthermore, among full-time employees, other instructors or human services personnel (88 percent) and business support or financial services personnel and computer/technical workers (81 percent each) were less likely than teachers to report that their jobs were related to their undergraduate fields of study.

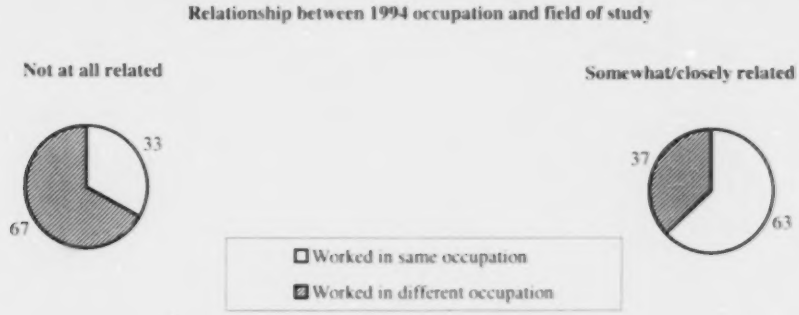
Among graduates who were working full time in April 1997, 93 percent of K–12 teachers reported that their jobs were somewhat or closely related to their graduate or undergraduate field of study, a proportion similar to that among those working full time as an engineer, scientist, or lab/research assistant (93 percent) or in a health occupation (92 percent). In April 1997, full-time K–12 teachers among 1992–93 college graduates were more likely than those working in all other occupation categories except legal occupations and editors, writers, and artists to report that their jobs were related to their postsecondary fields of study.

As one might expect, graduates who reported that their April 1994 occupations were somewhat or closely related to their undergraduate fields of study were considerably less likely than those who reported that their 1994 occupations were not at all related to work in a different occupation in April 1997. Whereas 37 percent of graduates with jobs related to their field of study in 1994 worked in a different occupation 3 years later, 67 percent of those with unrelated jobs did so (figure E).

Professional Status of April Occupations

Four-fifths of graduates who worked as full-time K–12 teachers in April 1994 believed that their teaching job both required a bachelor's degree and had possible or definite career potential. Although a similar proportion (79 percent) of graduates who worked full time as engineers, scientists, or lab/research assistants perceived their jobs as having similar professional status, graduates who worked full time in all other occupation

Figure E—Percentage distribution of 1992–93 bachelor's degree recipients who worked in both April 1994 and April 1997 according to whether the two occupations differed, by whether 1994 occupation was related to undergraduate field of study



NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

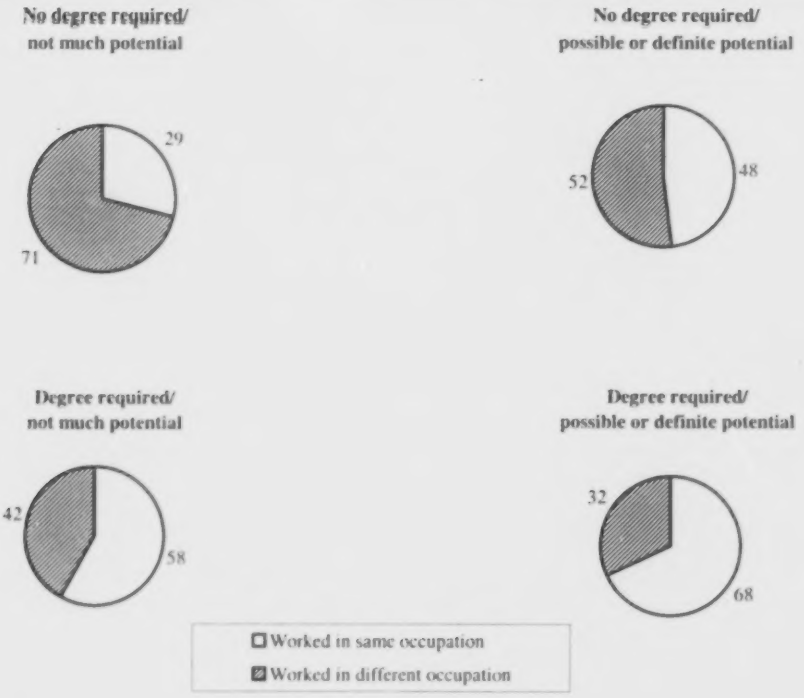
categories were less likely to share that perception. In April 1997, 78 percent of graduates employed full time as K–12 teachers reported that their jobs required a degree and had possible or definite career potential. In contrast, 68 percent or less of all other full-time employed graduates—except engineers, scientists, or lab/research assistants and those in legal occupations—reported the same. In 1997, full-time teachers were not more likely than part-time teachers to report that their jobs required a degree and had career potential.

Again as one might expect, graduates who perceived their April 1994 occupations as requiring a degree and having career potential were less likely than those who perceived otherwise to be working in a different occupation in April 1997. Among graduates who worked in both April 1994 and 1997, 32 percent of those who reported that their April 1994 jobs required a degree and had career potential were working in a different occupation in April 1997 (figure F). In contrast, 71 percent of those who reported that their 1994 job did not require a degree and did not have career potential worked in a different occupation 3 years later.

Changing Occupations: Multivariate Analysis

A multiple regression analysis was conducted to determine whether, after controlling for graduates' perceptions of their jobs' professional status and relationship to their undergraduate majors, occupation in 1994 remained associated with their likelihood of working in the same occupation in April 1997. The analysis indicated that after controlling for age, gender, college entrance examination scores, cumulative undergraduate GPAs, perceived professional status of occupation, and perceived relationship between April 1994 occupation and undergraduate major, teaching remained among the most stable occupations. In fact, graduates in no occupation category were more stable than teachers.

Figure F—Percentage distribution of 1992–93 bachelor's degree recipients who worked in both April 1994 and April 1997 according to whether the two occupations differed, by whether 1994 occupation required a bachelor's degree and had career potential



NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

Graduates' perceptions of their April 1994 job's professional status and of the relationship between their undergraduate field of study and their April 1994 job were, independently, related to whether they worked in the same occupation category at both points in time. Graduates who perceived their April 1994 job as unrelated or somewhat related to their undergraduate major field of study were less likely than those who perceived a close relationship to work in the same occupation in 1997 as in 1994. Graduates who reported that a degree was required to obtain their April 1994 occupation were more likely to work in the same occupation category at both points in time than were graduates who did not, although graduates' perceptions of the career potential of their jobs appeared not to make a difference.

Summary

Among graduates who were employed in April 1994 and April 1997, K–12 teachers (i.e., graduates who taught in 1994) were as likely as graduates who worked in other white collar, professional occupations to work in the same occupation category in April 1997. Specifically, approximately four-fifths of graduates who taught in April 1994 were also teaching in April 1997, and

similar proportions of graduates who worked in health occupations; as engineers, scientists, lab/research assistants; in legal occupations; in law enforcement or the military; or as business support/financial services workers worked in their respective occupation categories in both April 1994 and April 1997. Graduates who worked in other occupation categories in April 1994 were less likely than K–12 teachers to work in the same occupation category at both points in time.

Foreword

Although elementary/secondary school teachers are frequently the object of research attention, few data sources allow researchers to examine the career paths of teachers in the context of similarly educated employees in other occupations. Therefore, although education researchers have developed a considerable body of research on teachers' careers, it has not been clear whether or how teachers' careers differ from the career paths of other college graduates.

The 1993 Baccalaureate and Beyond Longitudinal Study (B&B:93) provides a unique opportunity to study such questions. B&B:93 has surveyed a sample of 1992–93 college graduates three times: in 1993, 1994, and 1997. These data allow researchers to study relationships between graduates' undergraduate experiences and their subsequent choices and experiences in graduate education and employment. In particular, each of the three surveys has included a component related to elementary/secondary teaching. This report takes advantage of these data to compare the later occupation choices made by graduates who taught early in their postbaccalaureate careers with those made by graduates who worked in other fields in the year following college graduation.

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B1b Standard errors for Figures 2 and 4: Percentage distribution of employed 1992–93 bachelor's degree recipients according to occupation, by employment status: April 1994 45

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Introduction

Although researchers have predicted teacher shortages for more than 15 years, it appears that as the century came to a close, these shortages had arrived.[1] The teacher shortages experienced in 1999–2000 were both field- and location-specific. For example, consumer sciences teachers in particular (Zehr 1998b) and vocational education teachers in general (Zehr 1998a) have been in short supply in many districts, and special education teachers are chronically difficult to hire (Sack 1999). In addition, particular states and localities are finding it harder than others to staff elementary/secondary classrooms (Archibold 1999; Steinberg 1999; Wilgoren 1999), and often these shortages occur in selected fields rather than across fields (Bradley 1999).

Increasing enrollments, particularly in the elementary grades; increasing rates of retirement among teachers; and the efforts of states and localities to reduce class size may well have contributed to many of these shortages (Johnson 2001). In recent years, enrollments in public and private elementary and secondary schools have grown considerably, and most expect that they will continue to climb through 2005, after which they are expected to drop slightly through 2010 (Gerald and Hussar 2000). Nevertheless, shortages may well continue since the proportion of teachers who retire each year is expected to rise (Goodnough 2000). As experienced baby-boomer teachers retire, they are likely to be replaced by young and inexperienced teachers, whose attrition rates are higher than those of mid-career teachers (Archer 1999; Grissmer and Kirby 1997).[2]

Many researchers and policymakers attribute the higher attrition rate among new teachers to their working conditions (e.g., Baker and Smith 1997). New teachers generally assume the same responsibilities that experienced teachers have and, unlike many other professions where new professionals are supervised by a more experienced colleague, often do so without the support of a mentor or supervisor. In addition, conventional wisdom maintains that new teachers receive the most difficult assignments (Archer 1999), which is consistent with data indicating that

[1]Schools and Staffing Survey (SASS) data collected between 1987–88 and 1993–94 did not provide evidence of general or specific teacher shortages in the U.S., despite predictions that such shortages would occur in the late 1980s and early 1990s (Darling-Hammond 1984; Henke, Choy, Geis, and Broughman 1996).

[2]Schools and Staffing Survey (SASS) data from 1994–95 indicate that about 8 percent of teachers who had taught less than 4 years left the profession since the previous school year, and that about 7 percent of teachers with 4 to 9 years of experience did so (Whitener et al. 1997). In contrast, between 4 and 5 percent of teachers with 10 to 24 years of experience left between 1993–94 and 1994–95. Other SASS estimates indicate that approximately 30 percent of new teachers leave the profession within the first 5 years of entry (Ingersoll as cited in Archer 1999).

teachers in schools serving large proportions of poor children have less experience than teachers serving more affluent children (Henke, Choy, Chen, Geis, and Alt 1997).

To encourage new teachers to remain in the profession, many states and localities have launched programs to support them. New Jersey, for example, created an alternative teacher preparation track, which provided new teachers with support from principals and experienced teachers (Cooperman 2000). Teachers who participated in this program left teaching at a rate of about 4 percent annually between 1984 and 1990, whereas teachers in the traditional teacher preparation track, which did not provide such support, left at a rate of 16 percent. In California, the Beginning Teacher Support and Assessment (BTSA) Program has grown dramatically in recent years as the state attempts to improve its rate of retaining new teachers. BTSA provides new teachers with mentors—experienced teachers who help new teachers solve problems, self-assess their weaknesses, and improve their teaching skills in the first 2 years of teaching. Some local BTSA programs are reporting retention rates of 85 to 90 percent (Archer 1999).

Policy analysts have also recommended that schools and districts professionalize teaching to improve retention (Kanstoroom and Finn 1999; Holmes Group 1986; National Commission on Teaching and America's Future (NCTAF) 1996, 1997). Specific measures to professionalize teaching include giving teachers more responsibility for school governance, creating career ladders for teachers, and increasing teacher salaries—particularly among experienced teachers—either across the board or according to merit. Since educators and analysts have noted that teachers with better preservice preparation are more likely than others to remain in the profession, many have proposed improving teacher preparation as a way to reduce teacher attrition and improve the quality of instruction.

Such policy initiatives may help new teachers become better teachers more quickly and may increase occupation stability among all teachers; however, they do not address other possible reasons for attrition among new teachers. Although such attrition has received considerable research attention over the years (Darling-Hammond 1984; Murnane et al. 1991), whether new teachers are more likely than college graduates beginning careers in other professions to change occupations has not yet been addressed. High attrition from initial occupations may be endemic to new college graduates' entry into the labor market, regardless of occupation, as new graduates learn about the workplace and about their strengths and weaknesses as well as what they like and dislike about their jobs. In addition, interest or aptitude for a field in an academic setting may not always translate into satisfaction in a related occupation. Particularly among graduates who majored in academic, rather than applied, fields of study, information about the kinds of work available to them and their affinity for it may be limited.

Furthermore, occupation attrition among new college graduates may be a function of graduates' perceptions of their early jobs in relation to their anticipated career paths, and certain occupations may serve as way stations for uncertain college graduates. For example, graduates who begin their work lives as teachers may be more or less likely than those in other occupations to perceive their job as a temporary one on the path to graduate school and a long-term career in another occupation.

Examining the attrition rates of new college graduates who simultaneously begin their careers in various occupations will provide contextual information that may help policymakers reduce attrition among new college graduates who become teachers. If new college graduates change occupations at similar rates regardless of their early occupations, reducing attrition among new teachers may be as much a matter of helping college students and new graduates choose, plan, and prepare for their careers as supporting new teachers and professionalizing teaching.

This research examines the occupation stability of bachelor's degree recipients during the first 4 years after receiving the bachelor's degree. The analyses address the following question: were graduates who were teaching in 1994 more or less likely than those in other occupations to leave the work force or work in a different occupation in 1997?

Data and Methodology

The 1993 Baccalaureate and Beyond Longitudinal Study (B&B:93) provided the data for these analyses. NCES first surveyed a nationally representative sample of about 11,200 students who received bachelor's degrees between July 1, 1992 and June 30, 1993 in spring 1993, and then again in 1994 and 1997. These analyses are based on about 9,300 graduates, or 83 percent of the original sample, who participated in all three B&B survey administrations.

These data provide an important opportunity to compare the behavior of a significant proportion of new teachers to that of their nonteaching peers. Results from these analyses cannot be generalized to all new teachers in 1994 or 1997 because many new teachers do not begin teaching immediately after completing a bachelor's degree. In 1993–94, 29 percent of newly hired teachers in public schools and 21 percent in private schools were newly prepared teachers, i.e., first time teachers who were attending college or had completed their highest degree the previous year (Broughman and Rollefson 2000). These newly prepared teachers are analogous to B&B:93 sample members who taught for the first time in April 1994. In 1993–94 delayed entrants—i.e., individuals who engaged in other activities between completing their teacher training and teaching at the K–12 level—made up 17 percent of newly hired teachers in public schools and 21 percent in private schools. These new teachers are not among those studied in this analysis of the B&B:93/97 data.

Graduates were asked whether they were enrolled in school and whether they were employed during April of both 1994 and 1997. Although the B&B:93 surveys collected information on graduates' employment and enrollment status during each month following their graduation, the surveys collected more detailed information—including occupation, industry, employer, career potential, and whether a degree was required to obtain their job—on the jobs they held in April of both years.

These analyses are based largely on composite variables developed from graduates' reports of what they were doing during both April 1994 and 1997. Composites were created to summarize graduates' major activities (e.g., working, studying, or both) in 1994 and 1997, whether their major activities differed between April 1994 and April 1997, and whether their occupations changed between the two years.

For April 1994 and 1997, variables describing graduates' employment status (B2EM9404 and B2EM9704) were crossed with variables describing graduates' enrollment status (B2EN9404 and B2EN9704) to create variables describing graduates' main activities during April 1994 and 1997 (ACT94 and ACT97). Graduates who lacked data on either their employment or enrollment status were not assigned a valid value on these variables. ACT94 and ACT97 include the following categories of graduates:

1. Employed full time and not enrolled
2. Employed part time and not enrolled
3. Employed full time and enrolled part time
4. Employed part time and enrolled part time
5. Employed full time and enrolled full time
6. Employed part time and enrolled full time
7. Unemployed, regardless of whether receiving unemployment benefits, and enrolled full time
8. Unemployed, regardless of whether receiving unemployment benefits, and enrolled part time
9. Out of the labor force and enrolled full time
10. Out of the labor force and enrolled part time
11. Unemployed and not enrolled
12. Out of the labor force and not enrolled

For the purposes of this report, the categories of these variables were combined into larger categories as follows:

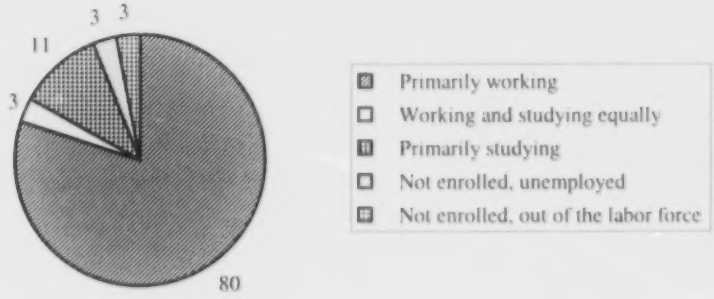
1. Graduates who were employed more than they were enrolled—categories 1–3 above—were classified as "primarily working";
2. Graduates who were employed and enrolled equal amounts of time—categories 4–5 above—were classified as "working and studying equally";
3. Graduates who were employed less than they were enrolled—categories 6–10 above—were classified as "primarily studying";
4. Graduates who were unemployed and not enrolled were classified as "unemployed"; and
5. Graduates who were not in the labor force and not enrolled were classified as "out of the labor force."

In addition, because the 1994 occupation coding scheme differed substantially from that used in 1997 and because discrepancies in coding were identified in the 1997 occupation code variable, both the occupation variables were recoded. The recoding process is described in appendix A.

Results

In April 1994, 80 percent of 1992–93 graduates were primarily working,[3] and another 3 percent combined study and work equally. The remaining graduates were primarily studying (11 percent), were not enrolled and either unemployed (3 percent), or were out of the labor force (3 percent) (figure 1).

Figure 1—Percentage distribution of 1992–93 bachelor's degree recipients according to main activity: April 1994



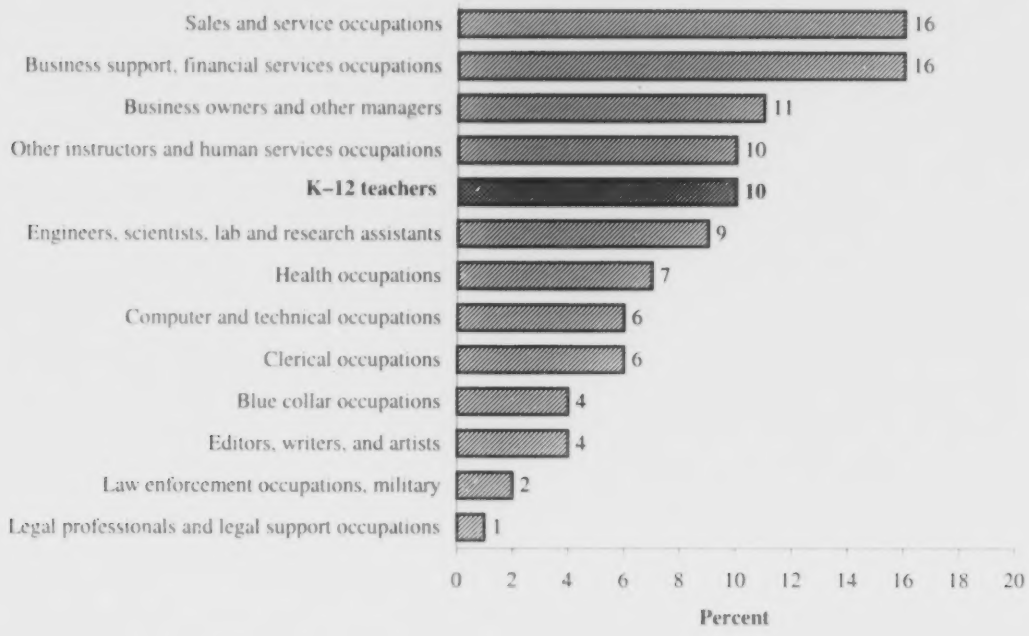
NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

Kindergarten through 12th-grade teachers made up 10 percent of graduates who were working full time in April 1994 (figure 2). In addition, approximately 16 percent of full-time employed graduates worked in sales or service positions, another 16 percent in business support or financial services positions, 11 percent as business owners and other managers, and 10 percent

[3]Graduates who were primarily working were working for pay full time or part time, but they were working more than they were studying. This category includes graduates who were working full time and either not enrolled or enrolled part time and graduates who were working part time and not enrolled.

Figure 2—Percentage distribution of 1992–93 bachelor's degree recipients who were employed full time according to occupation: April 1994



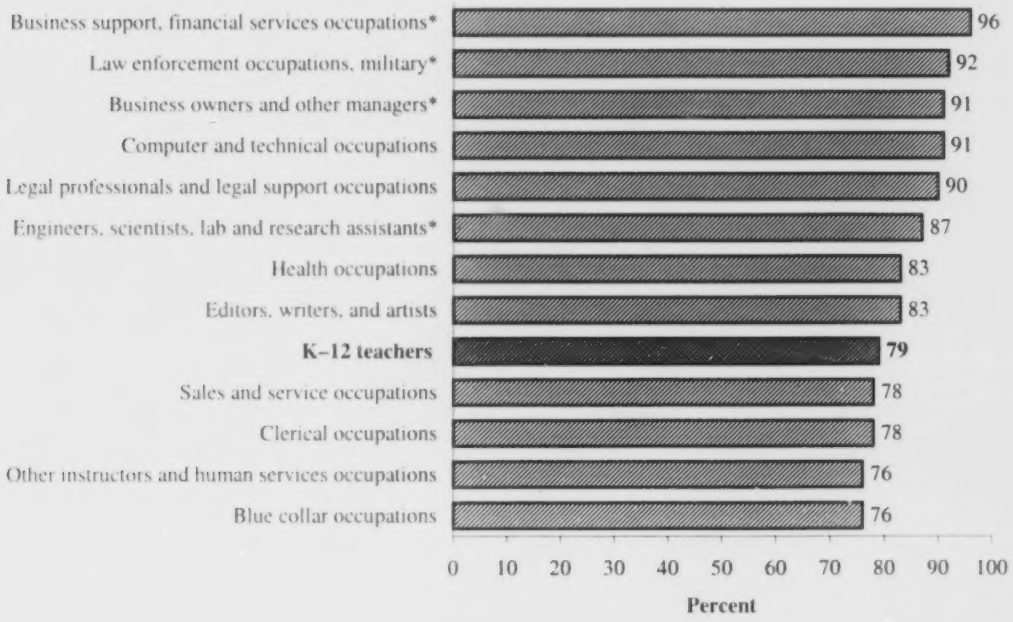
NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

as other instructors or human services professionals, such as social workers and religious leaders. The remaining 37 percent of graduates who were employed full time worked as engineers, scientists, or lab/research assistants; in health occupations; as computer or technical workers; in clerical or blue-collar jobs; as editors, writers, or artists; in law enforcement or the military; or in a legal occupation.

Four-fifths of graduates who worked as K–12 teachers in April 1994 worked full time. This proportion was lower than that among business support or financial services personnel; law enforcement or military personnel; business owners and other managers; and engineers, scientists, or lab/research assistants; however, it was comparable to that among employees in all other occupation categories (figure 3). Among graduates who worked part time, 14 percent worked as K–12 teachers (figure 4).

Figure 3—Percentage of 1992–93 bachelor's degree recipients who were employed full time, by occupation: April 1994

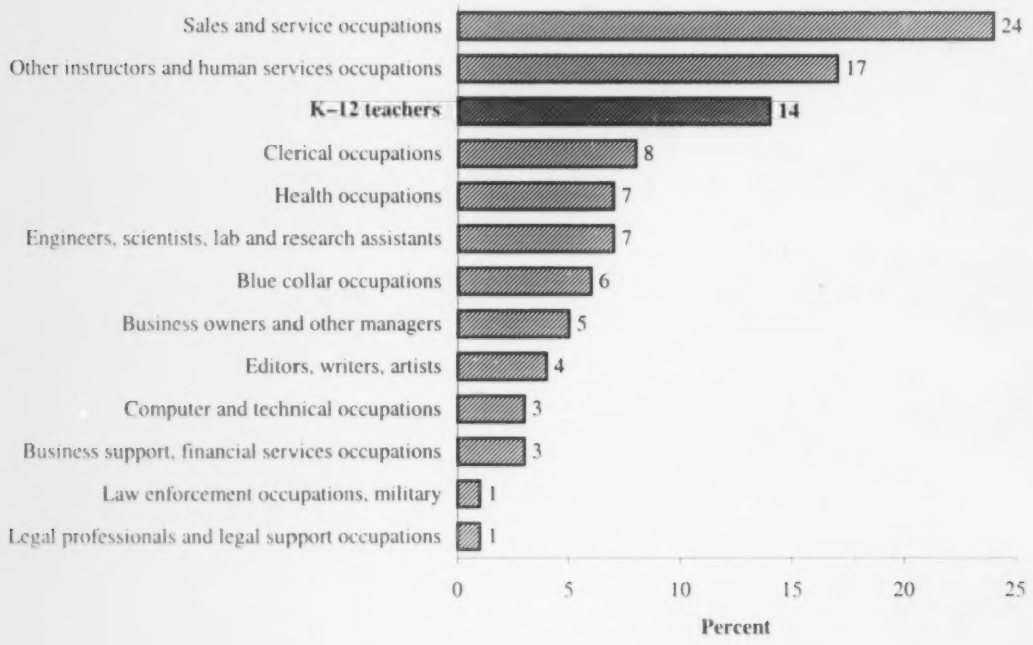


*Statistically significantly different from K–12 teachers at the .05 level.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

Whether they were employed full time or part time, most graduates who worked as K–12 teachers in April 1994 were also employed in April 1997. Among those employed full time as K–12 teachers in April 1994, 88 percent were primarily working, 3 percent were working and studying equal amounts, 3 percent were primarily studying, 1 percent were not enrolled and unemployed, and 4 percent were not enrolled and out of the labor force in April 1997 (figure 5). Among those employed part time as K–12 teachers in April 1994, 85 percent were primarily working, 5 percent were working and studying equal amounts, 3 percent were primarily studying, 3 percent were not enrolled and unemployed, and 5 percent were not enrolled and out of the labor force in April 1997.

Figure 4—Percentage distribution of 1992–93 bachelor's degree recipients who were employed part time according to occupation: April 1994



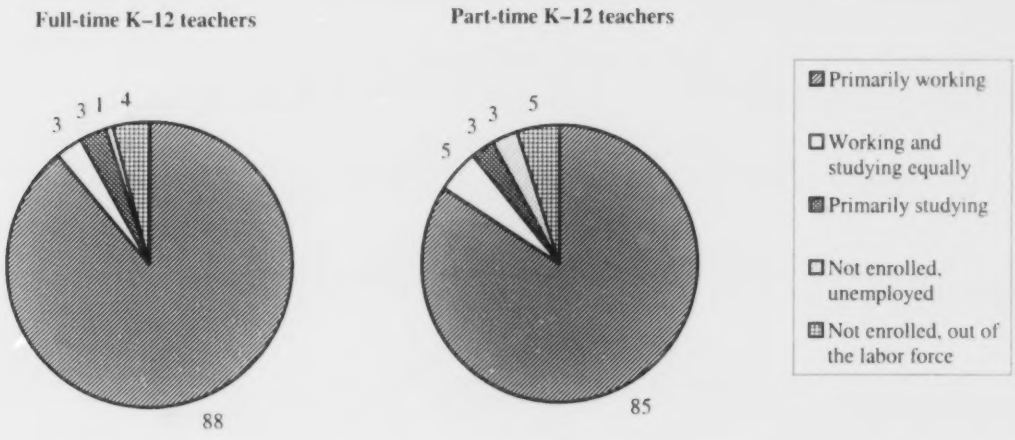
NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

Furthermore, among graduates who were employed full time as teachers in April 1994 and who were also working in April 1997, relatively few changed occupations. Among those who were full-time K–12 teachers in April 1994 and who also worked in April 1997, 82 percent remained in this occupation in April 1997 (figure 6). Among graduates who were working in April 1997, those who worked full time as K–12 teachers in April 1994 were as likely as those who worked in a health occupation; in law enforcement or the military; as engineers, scientists, or lab/research assistants; or as legal support personnel or legal professionals to work in the same occupation in April 1997.[4]

[4]There were relatively few graduates working in a legal occupation in April 1994 (see figure 2). Therefore, the standard error for the estimate of the percentage of these graduates who worked in the same occupation category in April 1997 is relatively large. This large standard error may account for the fact that no significant difference was found between the proportions of full-time K–12 teachers and legal support or professional personnel who worked in the same occupation category at both points in time.

Figure 5—Percentage distribution of 1992–93 bachelor's degree recipients who were employed as K–12 teachers in April 1994 according to main activity in April 1997, by April 1994 employment status



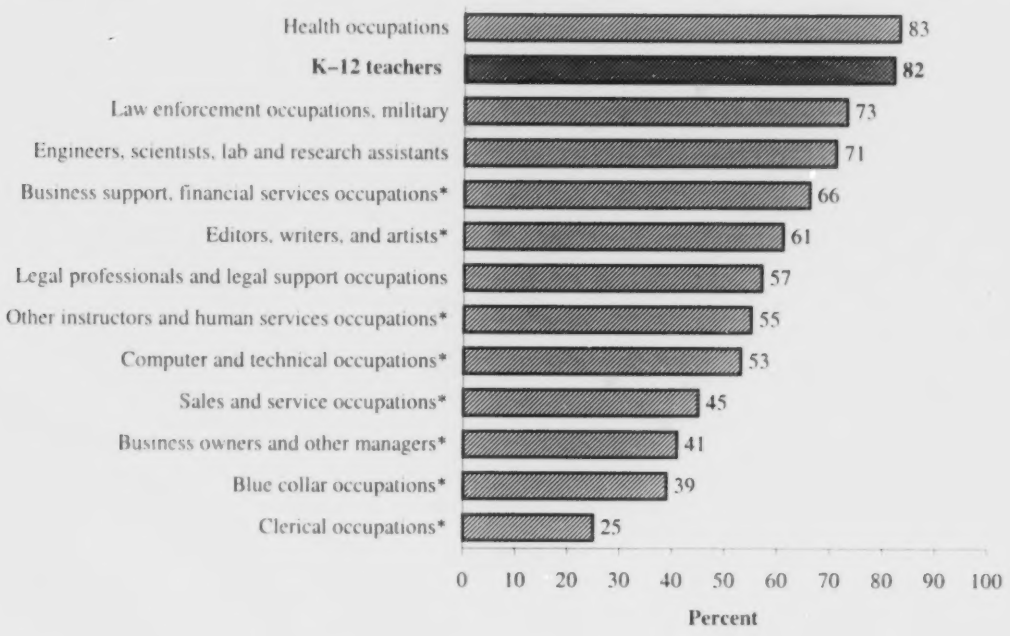
NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

In contrast, graduates who worked full time in April 1994 in any other occupation category were less likely than full-time K–12 teachers to still be in this occupation category in April 1997. Although one might expect such differences between K–12 teachers and clerical or blue-collar workers, K–12 teachers were also more likely than business support/financial services personnel; editors, writers, and artists; computer and technical workers; other instructors and human services personnel to work in the same occupation category in both 1994 and 1997.

Somewhat fewer of those who were working part time remained in teaching. Among April 1994 part-time K–12 teachers who worked in April 1997, 67 percent worked as K–12 teachers in April 1997 (figure 7). Among graduates who worked in April 1997, graduates who worked part time in April 1994 as K–12 teachers were more likely than those who worked part time as computer or technical workers, sales/service representatives, blue-collar workers, business owners and other managers, or clerical workers to work in the same occupation in April 1997. In other words, part-time K–12 teachers were as likely as graduates who worked part time in the remaining occupations to work in the same occupation in both time periods.

Figure 6—Among 1992–93 bachelor's degree recipients who worked full time in April 1994, percentage who worked in the same occupation category in April 1997, by April 1994 occupation

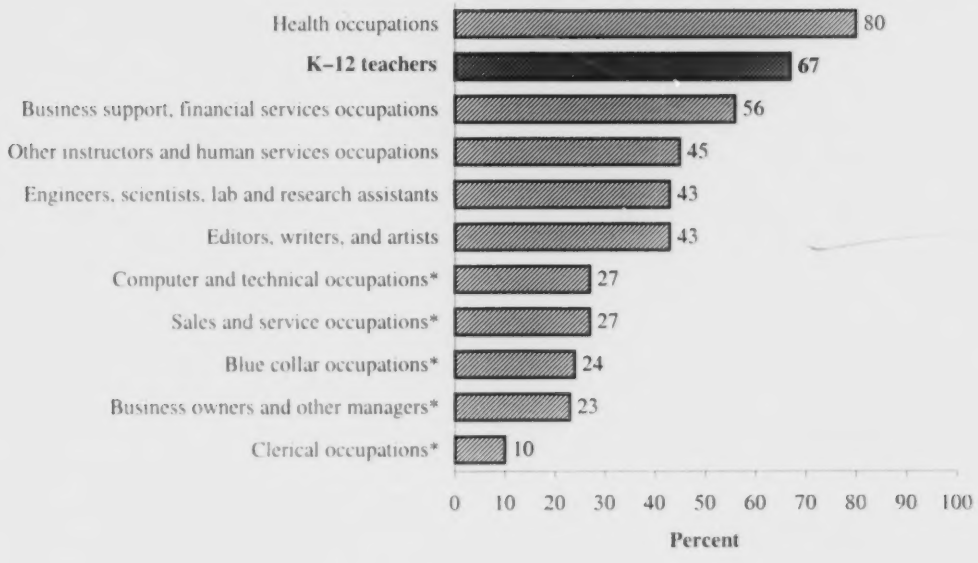


*Statistically significantly different from K–12 teachers at the .05 level.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

Thus, 1992–93 college graduates who worked as K–12 teachers in April 1994 were less likely than graduates in many other occupation categories to be working in another occupation, studying primarily, not enrolled and unemployed, or not enrolled and out of the labor force in April 1997. However, this analysis examines graduates' activities and occupations at only two points in time: April 1994 and April 1997. Graduates who had taught in April 1994 may have been more likely than graduates in other occupations to leave teaching after April 1994—in order to work toward a teaching certificate or master's degree, for example—and return by April 1997. The data illustrate this point to some degree. Among graduates who were primarily working and employed full time in April 1994, those who worked as K–12 teachers were more likely than

Figure 7—Among 1992–93 bachelor's degree recipients who worked part time in April 1994, percentage who worked in the same occupation category in April 1997, by April 1994 occupation



*Statistically significantly different from K–12 teachers at the .05 level.

NOTE: Too few sample members worked part time in law enforcement, the military, or a legal profession to produce reliable estimates for these categories.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

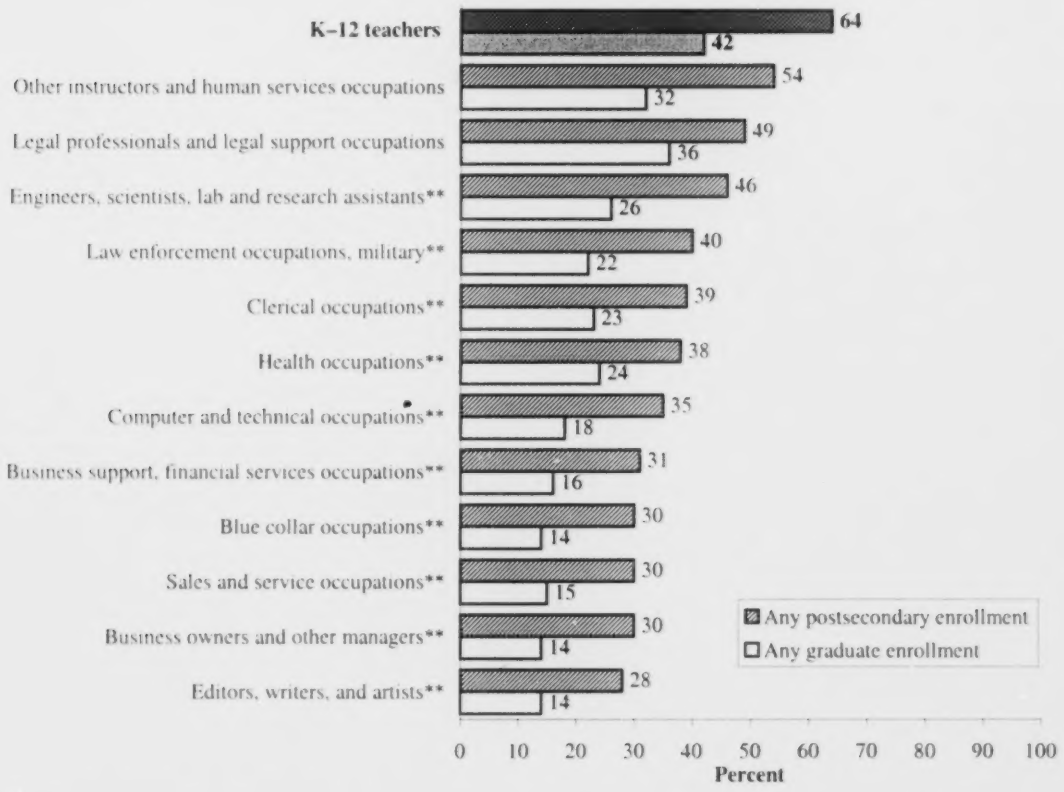
most others to have enrolled at any postsecondary or graduate level between completing the 1992–93 bachelor's degree and April 1997 (figure 8).[5] Such higher rates of postsecondary enrollment among teachers may reflect school district salary schedules, which commonly reward teachers for earning postsecondary education units.[6]

Finally, in addition to perceptions that the overall new teacher attrition rate is high, policymakers and researchers fear that, among teachers, those who major in fields other than education, particularly mathematics and the natural sciences, are more likely than education majors to leave

[5]Elementary/secondary teaching graduates were no more likely than graduates who worked full time in April 1994 as other instructors or human services personnel or those in legal occupations to enroll at either level after completing the bachelor's degree.

[6]These data do not completely address the question of whether new teachers were more likely than those in other occupations to leave and return within the three year period between April 1994 and April 1997. Those who did enroll at a postsecondary institution, as well as those who did not, may have continued working in their April 1994 occupation, changed occupations, or stopped working completely for any or all of the period between April 1994 and April 1997.

Figure 8—Among 1992–93 bachelor's degree recipients who were primarily working and employed full time in April 1994, percentages who had enrolled at the postsecondary and at the graduate levels by April 1997, by April 1994 occupation

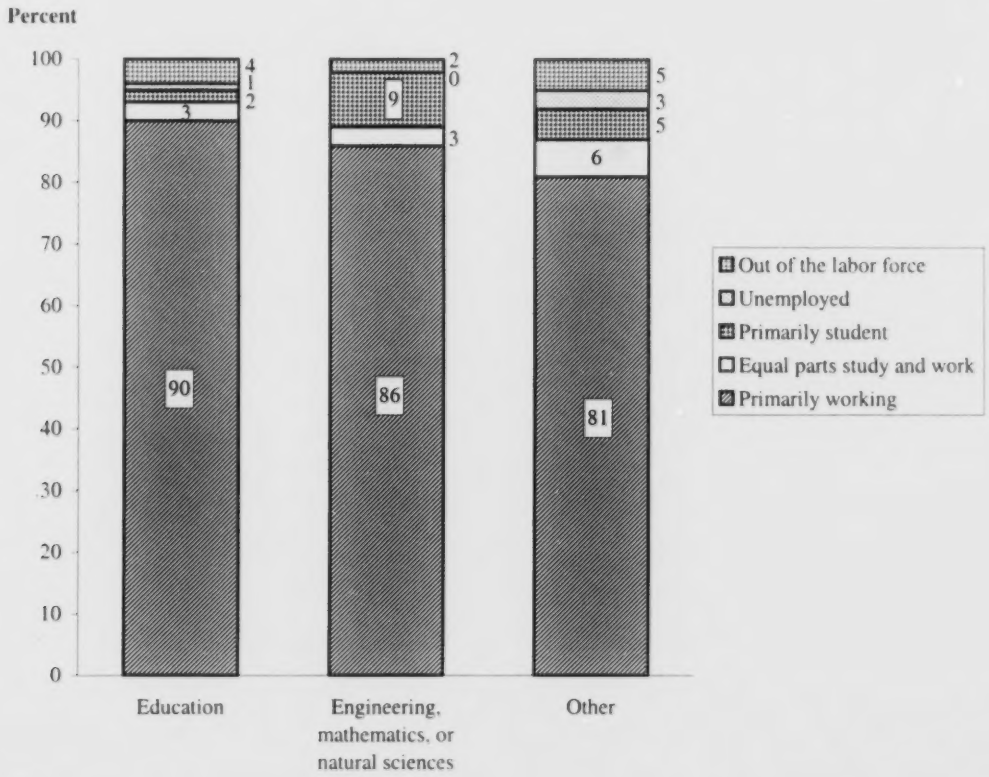


**Both estimates statistically significantly different from K–12 teachers at the .05 level.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

the profession. The B&B:93/97 data indicate there was no difference between teachers who majored in education and those who majored in engineering, mathematics or the natural sciences in the proportion who were primarily working in April 1997 (figure 9). However, among graduates who worked as K–12 teachers in April 1994 and who were working in April 1997, 70 percent of those who had majored in engineering, mathematics, or the natural sciences were teaching at the K–12 level in April 1997, compared with 86 percent of education majors (figure 10).

Figure 9—Among 1992–93 bachelor's degree recipients who taught at the K–12 level in April 1994, percentage distribution according to main activity in April 1997, by undergraduate major

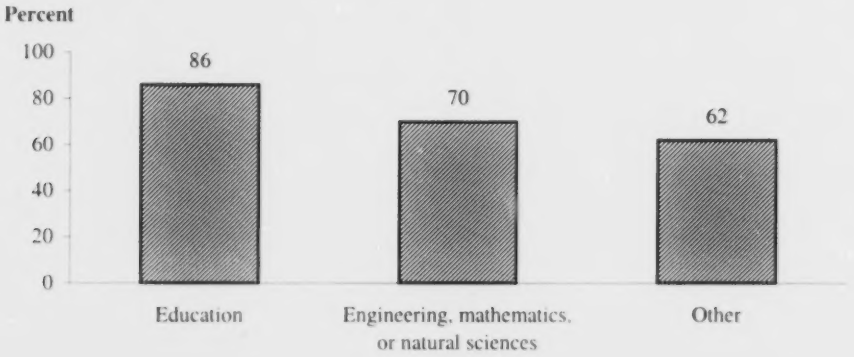


NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

Thus, this analysis indicates that among 1992–93 college graduates who worked in April 1994, approximately a year after they had completed their bachelor's degrees, those who taught at the K–12 level were among the least likely of all employed graduates to work in a different profession 3 years later. Relatively few K–12 teaching graduates had different main activities or different occupations in April 1997 than they did in April 1994. Attrition rates among teachers varied with major, however: April 1994 K–12 teaching graduates who had majored in engineering, mathematics, or the natural sciences were less likely than those who had majored in education to be teaching in April 1997.

Figure 10—Among 1992–93 bachelor's degree recipients who taught at the K–12 level in April 1994 and who were working in April 1997, percentage who worked as K–12 teachers in April 1997, by undergraduate major



SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

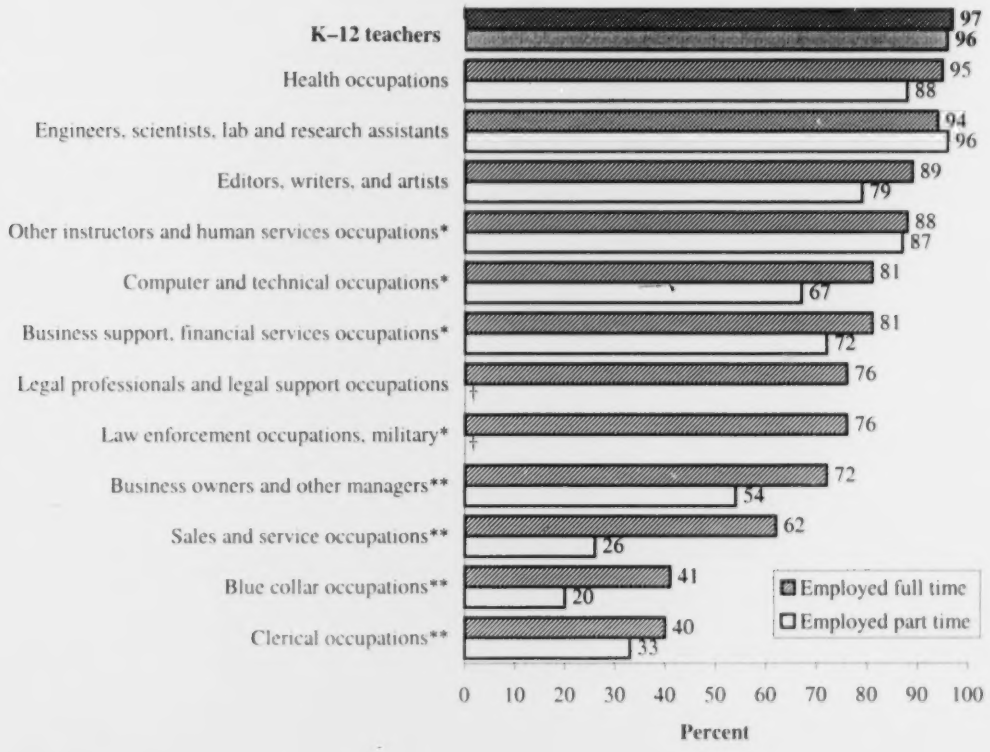
The remainder of this report examines whether two additional variables—graduates' perceptions of how their postsecondary fields of study were related to their occupations and their views about the professional status of their occupations—vary with occupations and are associated with changing occupations between April 1994 and April 1997.

Relationship Between April Occupations and Postsecondary Fields of Study

Among those working as K–12 teachers in April 1994, nearly all reported that their jobs were related to their undergraduate field of study (97 percent among full-time teachers and 96 percent among part-time teachers) (figure 11). Similarly, most graduates who worked either full time or part time in a health occupation or as engineers, scientists, or lab/research assistants indicated that their jobs were related to their undergraduate major.

Graduates who worked in other occupations in April 1994 were considerably less likely to report that their jobs were related to their undergraduate majors. As one might expect, graduates who worked full time or part time in clerical, blue-collar, or sales or service occupations were less likely than teachers to report that their jobs were related to their undergraduate majors: 62 percent or less of graduates in these occupations did so. In addition, both full- and part-time business owners and other managers were less likely than teachers to report that their jobs were related to their undergraduate fields of study. Likewise, among full-time employees, other instructors or human services personnel (88 percent) and business support or financial services

Figure 11—Percentage of 1992–93 bachelor's degree recipients who reported that their job was related to their undergraduate field of study, by employment status and occupation: April 1994



*Full-time estimate statistically significantly different from K–12 teachers at the .05 level.

**Both estimates statistically significantly different from K–12 teachers at the .05 level.

†Sample size too small for a reliable estimate.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

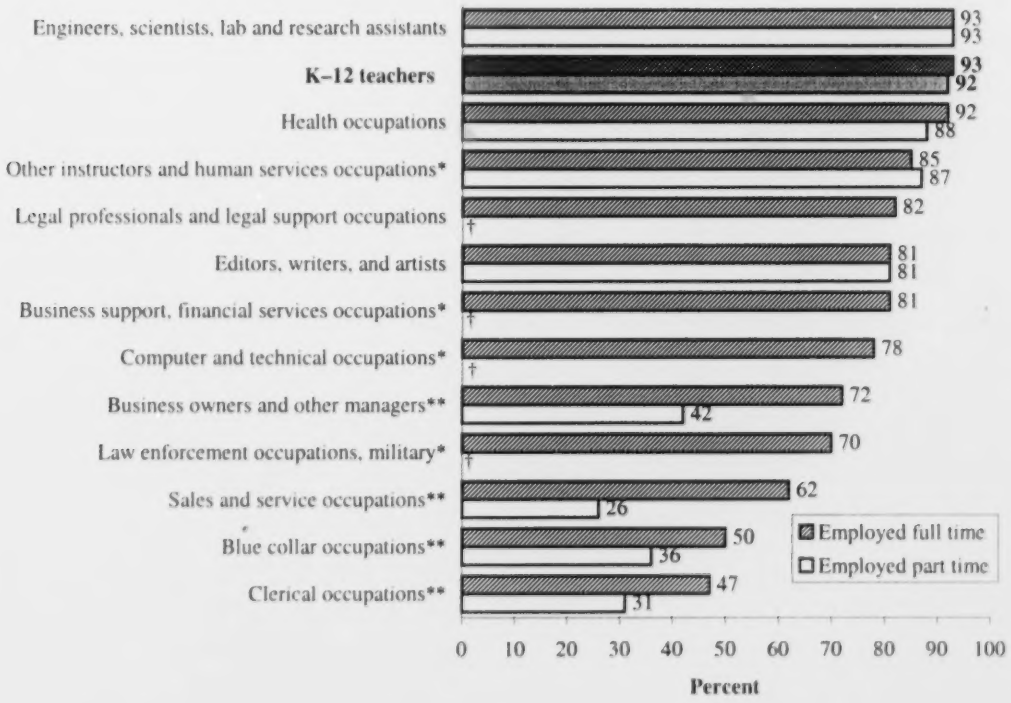
personnel and computer/technical workers (81 percent each) were less likely than teachers to report that their jobs were related to their undergraduate fields of study.

Among graduates who were working full time in April 1997, 93 percent of K–12 teachers reported that their jobs were somewhat or closely related to their graduate or undergraduate fields of study, a proportion similar to that among those working full time as an engineer, scientist, or lab/research assistant (93 percent) or in a health occupation (92 percent) (figure 12). In April 1997, full-time K–12 teachers among 1992–93 college graduates were more likely than

those working in the remaining occupation categories, except legal occupations and editors, writers, and artists, to report that their jobs were related to their postsecondary fields of study.

Among graduates who worked part time in April 1997, 92 percent of K–12 teachers reported that their jobs were related to a postsecondary field of study, a proportion similar to that among part-time engineers, scientists, and lab/research assistants (93 percent); health occupations workers (88 percent); other instructors and human services personnel (87 percent); and editors, writers, and artists (81 percent) (figure 12). Graduates who worked as part-time business owners and other managers, blue-collar workers, clerical employees, or in sales or service jobs were less likely than part-time teachers to perceive their jobs as related to a postsecondary field of study.

Figure 12—Percentage of 1992–93 bachelor's degree recipients who reported that their job was related to their undergraduate or graduate field of study, by employment status and occupation: April 1997



*Full-time estimate statistically significantly different from K–12 teachers at the .05 level.

**Both estimates statistically significantly different from K–12 teachers at the .05 level.

†Sample size too small for a reliable estimate.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

To assess whether graduates who perceived their 1994 occupations to be related to their undergraduate fields of study were more likely to work in a different occupation in April 1997, a new variable was created to measure occupation change. This variable compared the April 1994 occupation category with that in April 1997: if the two were identical, the graduate was defined as "not having changed occupations." The variable also took into consideration that in many occupational areas, employees may change occupations but remain in a career path within a field. For example, if in April 1994 a graduate worked as a research assistant, and in April 1997 as a scientist or researcher, that graduate was defined as "not having changed occupation." Similarly, graduates whose April 1994 occupation was classified as business support or financial services and whose April 1997 occupation was classified as financial services professional were defined as "not having changed occupation." However, K–12 teachers were required to fall in the same occupation category at both points in time to be defined as "not having changed occupation." Appendix A provides more detail about which combinations of occupation categories were defined as "changes."

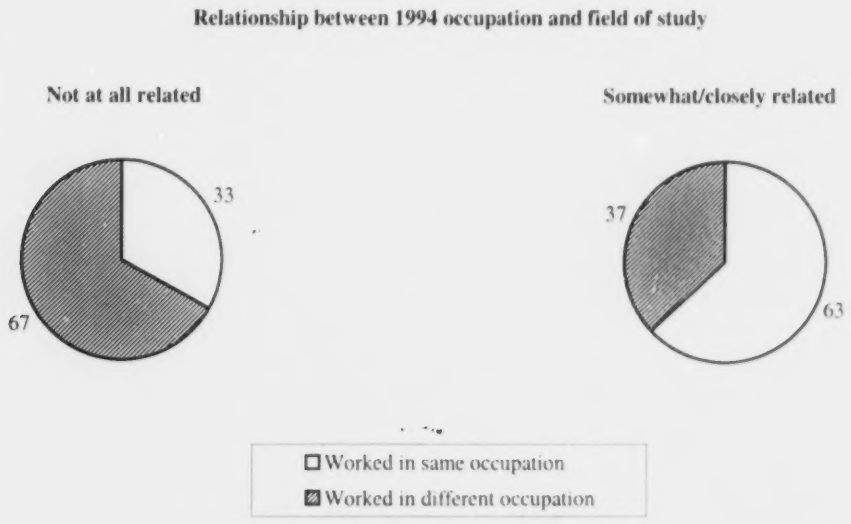
Compared with those who reported that their April 1994 occupations were not at all related to their undergraduate fields of study, graduates who reported that their 1994 occupations were somewhat or closely related were considerably less likely to work in a different occupation in April 1997. Whereas 37 percent of graduates with jobs related to their field of study worked in a different occupation 3 years later, 67 percent of those with unrelated jobs did so (figure 13).

Professional Status of April Occupations

Four-fifths of graduates who worked as full-time K–12 teachers in April 1994 believed their teaching job both required a bachelor's degree and had possible or definite career potential (figure 14). Although a similar proportion (79 percent) of graduates who worked full time as engineers, scientists, and lab/research assistants perceived their jobs as having similar professional status, graduates who worked full time in all other occupation categories were less likely to share that perception.

Part-time teachers among graduates were less likely than their full-time counterparts to rate their jobs as both requiring a degree and having career potential. However, 64 percent of part-time teachers did so, a higher proportion than among graduates working part time as other instructors or human services personnel; editors, writers, and artists; computer/technical workers; business owners and other managers; clerical and blue-collar workers; and sales/service people.

Figure 13—Percentage distribution of 1992–93 bachelor's degree recipients who worked in both April 1994 and April 1997 according to whether the two occupations differed, by whether 1994 occupation was related to undergraduate field of study

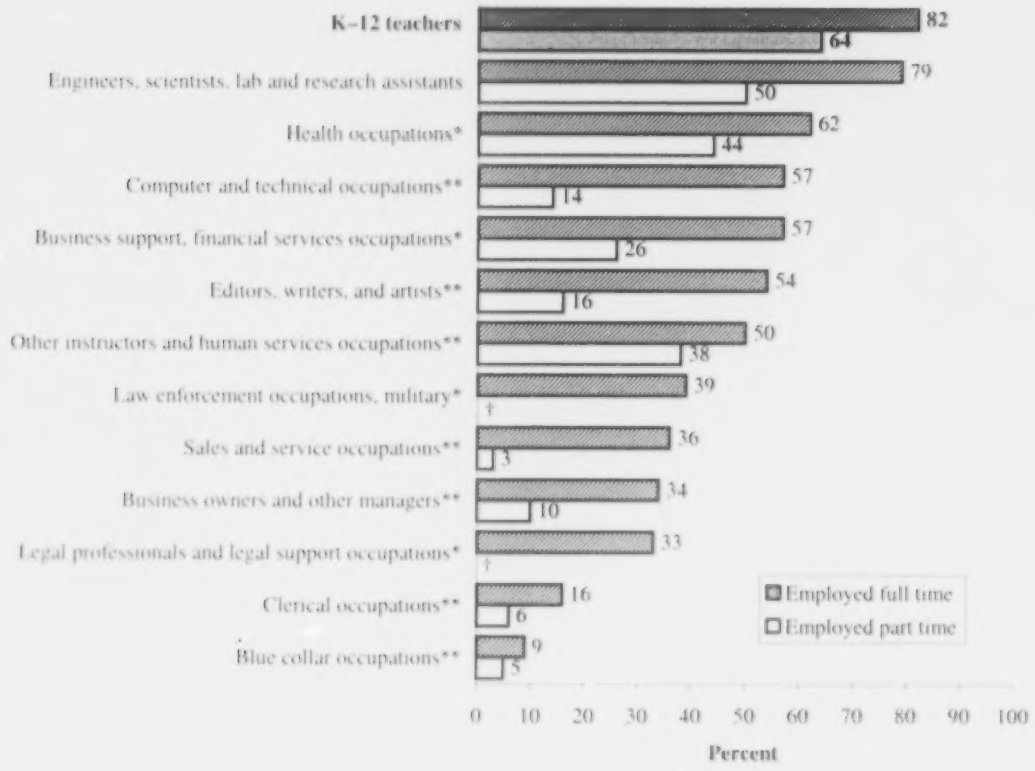


NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

In April 1997, 78 percent of graduates who were employed full time as K–12 teachers reported that their jobs required a degree and had possible or definite career potential (figure 15). In contrast, 68 percent or less of all other full-time employed graduates—except engineers, scientists, and lab/research assistants and those in legal occupations—reported the same. Among part-time employed graduates, 71 percent of K–12 teachers reported that their jobs required a degree and had possible or definite career potential, compared with 22 percent or less among editors, writers, and artists; business owners and other managers; and blue-collar, clerical, and sales/service employees. Approximately 50 percent of graduates who worked part time as health workers; other instructors or human services personnel; or engineers, scientists, or lab/research assistants did so—proportions that did not differ from those of K–12 teachers. In contrast to 1994, in 1997 full-time teachers were not more likely than part-time teachers to report that their jobs required a degree and had career potential.

Figure 14—Percentage of 1992–93 bachelor's degree recipients who reported that their job had career potential and that a bachelor's degree was required to obtain the job, by employment status and occupation: April 1994



*Full-time estimate statistically significantly different from K–12 teachers at the .05 level.

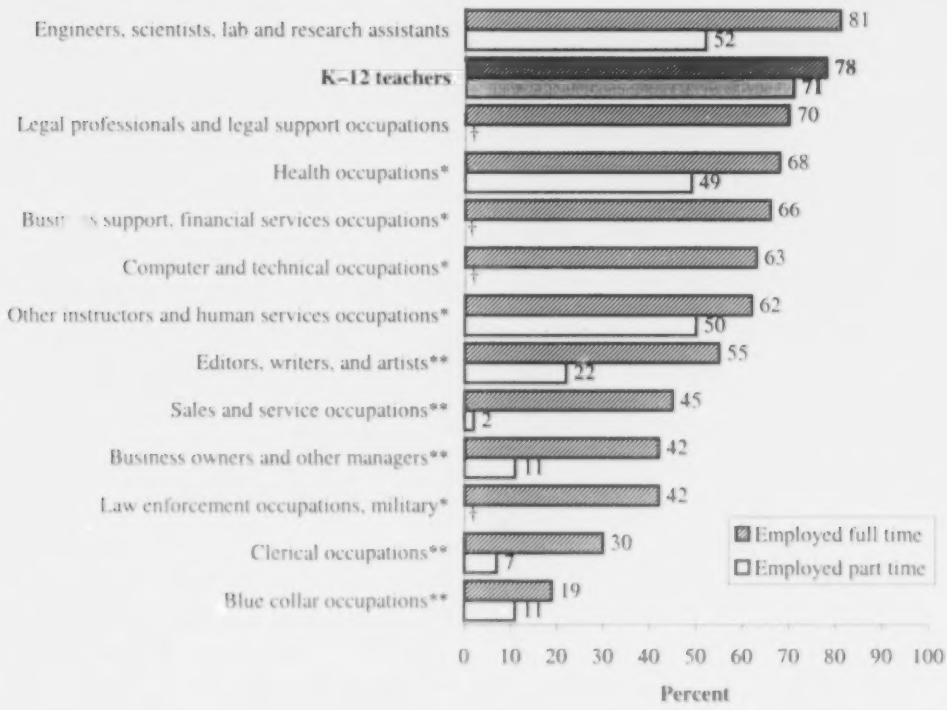
**Both estimates statistically significantly different from K–12 teachers at the .05 level.

†Sample size too small for a reliable estimate.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

As one might expect, graduates who perceived their April 1994 occupations as requiring a degree and having career potential were less likely than those who perceived otherwise to be working in a different occupation in April 1997. Among graduates who worked in April of both 1994 and 1997, 32 percent of those who reported that their April 1994 jobs required a degree and had career potential were working in a different occupation in April 1997 (figure 16). In contrast, 71 percent of those who reported that their 1994 job did not require a degree and did not have career potential worked in a different occupation 3 years later.

Figure 15—Percentage of 1992–93 bachelor's degree recipients who reported that their job had career potential and that a bachelor's degree was required to obtain the job, by employment status and occupation: April 1997



*Full-time estimate statistically significantly different from K–12 teachers at the .05 level.

**Both estimates statistically significantly different from K–12 teachers at the .05 level.

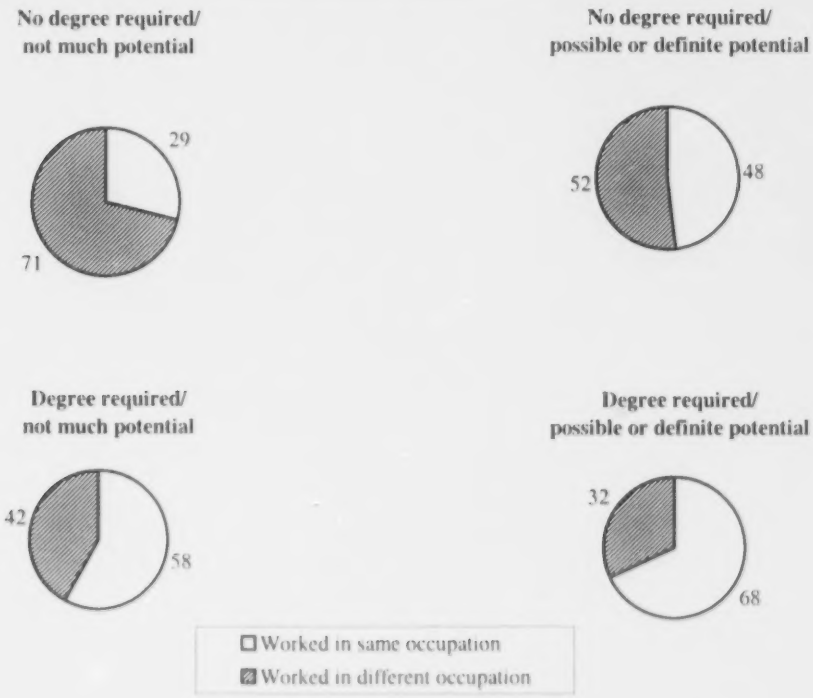
†Sample size too small for a reliable estimate.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

Changing Occupations: Multivariate Analysis

The bivariate results discussed thus far indicate that many of the variables examined are related to each other as well as to the probability of graduates' changing occupations between April 1994 and April 1997. Rates of change were related to graduates' 1994 occupations, their perceptions of their jobs' professional status and relationship to their postsecondary fields of study. Graduates' perceptions also were related to their occupations. Multivariate techniques allow researchers to disentangle some of this covariation.

Figure 16—Percentage distribution of 1992–93 bachelor's degree recipients who worked in both April 1994 and April 1997 according to whether the two occupations differed, by whether 1994 occupation required a bachelor's degree and had career potential



NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

Table 1 presents two estimates of the proportion of graduates who worked in the same occupation at both points in time. The first column of estimates presents unadjusted percentages of graduates who did not change their occupations, based on the occupation change variable discussed above. The second column of estimates presents percentages, based on the same variable, that have been adjusted to take into account covariation among the independent variables in the table and the additional variables age and cumulative undergraduate grade point average.[7]

[7]These additional variables are not shown in the table because they are continuous variables. Of these two additional variables, only age was a significant predictor of graduates' working in the same occupation category at both times. The coefficient for age indicates that older graduates were slightly more likely than younger graduates to work in the same occupation category in April 1994 and 1997.

Table 1—Among 1992–93 bachelor's degree recipients who were employed in both April 1994 and April 1997 percentage who worked in the same occupation category at the two points in time, unadjusted and adjusted after controlling for variables listed in the table[1]

	Unadjusted Percentages[2]	Adjusted percentages[3]	WLS coefficient[4]	Standard error[5]
Total	53.4	53.4	62.4	9.93
Main activity, April 1994				
Primarily working	*55.0*	*54.0*	†	†
Primarily student	27.4	44.2	-9.8	6.85
Equal parts study and work	43.9	49.3	-4.7	6.36
April 1994 occupation				
K–12 teachers	*78.8*	*69.0*	†	†
Health occupations	82.2	74.2	5.2	5.87
Engineers, scientists, lab and research assistants	70.4	63.7	-5.2	5.74
Business support, financial services occupations	70.2	67.4	-1.6	5.11
Law enforcement occupations, military	67.5	65.2	-3.8	9.25
Legal professionals and legal support occupations	60.1	61.1	-7.9	13.50
Editors, writers, and artists	53.0*	50.4*	-18.6	7.27
Computer and technical occupations	51.8*	48.8*	-20.2	6.51
Other instructors and human services occupations	48.0*	46.5*	-22.5	5.25
Business owners and other managers	35.3*	37.6*	-31.4	5.70
Sales and service occupations	33.6*	42.3*	-26.7	5.21
Blue collar occupations	27.6*	39.6*	-29.5	7.63
Clerical occupations	21.8*	34.8*	-34.2	6.67
Relationship between undergraduate field of study and April 1994 occupation				
Closely related	*67.8*	*60.5*	†	†
Somewhat related	42.9	46.1*	-14.4	3.29
Not at all	29.1	43.1*	-17.4	3.57
Employment status in April 1994				
Full-time employed in April 1994	*56.5*	*54.7*	†	†
Part-time employed in April 1994	36.3	46.3*	-8.5	3.94
Gender				
Male	*52.3*	*54.1*	†	†
Female	54.3	52.7	-1.4	2.62
Professional status of April 1994 job				
Degree required, possible or definite potential	*67.5*	*58.9*	†	†
Degree required, not much potential	55.0	52.9	-6.0	4.28
No degree required, possible or definite potential	45.9	51.1*	-7.8	3.25
No degree required, no potential	26.0	42.5*	-16.4	4.03
College entrance examination score				
Top quartile SAT (or ACT if no SAT)	*49.8*	*51.2*	†	†
Third quartile SAT (or ACT if no SAT)	52.2	53.5	2.2	3.48
Second quartile SAT (or ACT if no SAT)	52.9	54.0	2.7	3.53
Bottom quartile SAT (or ACT if no SAT)	52.6	54.5	3.2	3.75

*$p \leq .05$.

†Not applicable for the reference group.

[1]The italicized group in each category is the reference group being compared.

[2]The estimates are from the B&B:93/97 Data Analysis System.

[3]The percentages are adjusted for differences associated with other variables in the table, age, and cumulative undergraduate GPA (see appendix B). Age and cumulative undergraduate GPA were not included in the table because they are continuous variables.

[4]Weighted least squares (WLS) coefficient, multiplied by 100 to reflect percentage (see appendix B).

[5]Standard error of WLS coefficient, adjusted for design effect, multiplied by 100 to reflect percentage (see appendix B).

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

After controlling for the other variables in the model, graduates who taught in April 1994 were as likely to be teaching in April 1997 as graduates who worked in most other professions were not to change occupations. Graduates who worked in health occupations; in business support/financial services occupations; in law enforcement and the military; as engineers, scientists, and lab/research assistants; and legal occupations in 1994 were no more likely than teachers to be working in their occupation categories in 1997 as well. In fact, no occupation category was more stable than teachers.

Graduates' perceptions of their April 1994 job's professional status and of the relationship between their undergraduate field of study and their April 1994 job were, independently, related to whether they worked in the same occupation category at both points in time. Graduates who perceived their April 1994 job as unrelated or somewhat related to their undergraduate major field of study were less likely than those who perceived a close relationship to work in the same occupation in 1997 as in 1994. Compared with graduates who reported that a degree was not required to obtain their April 1994 job, graduates who reported that a degree was required were more likely to work in the same occupation category at both points in time. However, graduates' perceptions of the career potential of their jobs appeared not to make a difference.

In addition to these variables related to the type of job graduates were doing, their employment status was associated with the likelihood that they changed occupations, after adjusting for covariation of employment status with the remaining variables in the model. Graduates who worked full time in April 1994 were more likely than part-time employees to work in the same occupation category in April 1997. However, whether graduates were primarily working, combining work and study equally, or primarily studying in April 1994 was not associated with working in the same occupation category in April 1997.

Conclusion

Concern about K–12 teacher shortages has raised questions regarding the attrition rate among teachers, and particularly new teachers. This analysis examined whether 1992–93 bachelor's degree recipients who taught at the elementary/secondary level in 1994 were less likely to work in the same occupation in 1997, compared with their peers in other occupations. The data indicate that K–12 teachers among 1992–93 college graduates were among the least likely to work in different occupations in 1997 compared with 1994.

Among graduates who were employed in April 1994 and April 1997, K–12 teachers (i.e., graduates who taught in 1994) were as likely as graduates who worked in other white collar, professional occupations to work in the same occupation category in April 1997. Specifically, approximately four-fifths of graduates who taught in April 1994 were also teaching in April 1997, and similar proportions of graduates who worked as health occupations professionals; engineers, scientists, lab/research assistants; in legal occupations; in law enforcement or the military; or as business support/financial services workers worked in their respective occupation categories in both April 1994 and April 1997. Graduates who worked in other occupation categories in April 1994 were *less* likely than K–12 teachers to work in the same occupation category at both points in time.

Moreover, this result occurred in spite of the fact that teachers were held to a higher standard. Teachers were defined as not changing occupations if they worked as K–12 teachers at both points in time, whereas graduates who worked in other occupations were defined as not changing occupations if they worked in the same occupation categories or, in some cases, related occupation categories.

Those who taught at the K–12 level part time in April 1994 were less likely than their full-time counterparts also to work as K–12 teachers in April 1997. Nevertheless, among part-time workers in April 1994, K–12 teachers were among the most likely of all occupation categories to work in the same occupation category in April 1997 as in April 1994.

Graduates' perceptions of whether their April 1994 occupations were closely related to their undergraduate field of study and of the professional status of the April 1994 occupation were related to whether they worked in the same occupation category in both April 1994 and April 1997. Graduates who reported that their April 1994 occupations were somewhat or closely

related to their undergraduate fields of study were considerably less likely than those who reported that their 1994 occupations were not at all related to work in a different occupation category in April 1997. As one might expect, graduates who perceived their April 1994 occupations as having professional status, defined as requiring a degree and having career potential, were less likely than those who perceived otherwise to be working in a different occupation in April 1997. Consistent with these findings, in both 1994 and 1997, 1992–93 college graduates who worked as K–12 teachers were highly likely to report that their jobs were related to their postsecondary fields of study and had professional status.

There are several points to keep in mind regarding the major finding of this report: K–12 teachers were among the least likely of 1992–93 bachelor's degree recipients to change occupations between April 1994 and April 1997. First, the estimates regarding occupation attrition that are presented in this report include only those graduates who worked in April 1994 and April 1997. Therefore, they do not take into account attrition from particular occupations in April 1994 to nonwork (e.g., studying or child rearing) in April 1997. However, as the analysis of main activity changes between 1994 and 1997 demonstrates, most graduates, including those who worked as K–12 teachers, did work in both April 1994 and 1997. Consequently, these estimates are not likely to vary much from estimates that do take into account departures from the work force as well as changes in occupation.

Second, although the estimates of attrition among new teachers reported here appear to be lower than many discussed among policymakers and in news reports, there are many potential reasons for such differences. These data do not represent all new teachers in April 1994, but only new teachers among 1992–93 bachelor's degree recipients. Given independent estimates of the proportion of teachers who are new college graduates, this group is likely to represent between one-half and two-thirds of all first-time teachers in April 1994. Therefore, many new teachers in April 1994 (i.e., those who received their bachelor's degrees before July 1992) are omitted from the analysis.

Third, these results must also be interpreted in the context of labor market conditions of the mid 1990s and other influences associated with this point in time. For example, data from 1999–2000 graduates might support quite different findings, given the booming economy and the potential for new college graduates to earn relatively large salaries in technology related occupations.

Fourth, this analysis is limited to two points in time, and does not take into account stopping out behavior between April 1994 and April 1997. Such behavior may vary among graduates

in different occupations, and also may account for differences between these attrition rates and others calculated over different periods of time in a graduate's career.

Finally, this report discusses attrition from graduates' April 1994 occupations, and not turnover within those occupations. Turnover among jobs within occupations may vary among occupations in different ways than attrition does. For example, although K–12 teachers among recent college graduates have relatively low attrition rates, they may have relatively high turnover rates compared with their classmates in other occupations. High turnover rates would also have policy implications for schools and districts, particularly if some schools were more likely than others to have high turnover rates among new teachers.

In sum, the point of the analysis is not to estimate the proportion of new teachers who changed occupations but to examine their attrition rates relative to that of other college graduates who are at similar points in their careers but in different occupations. In that regard, the analysis indicates that college graduates who teach soon after completing their degrees are among the most stable in terms of occupational choice. Many new graduates did work in different occupations 4 years after completing their degrees compared with their occupation 1 year after completion. However, those who were teaching at the 1-year point were less likely, as were others in occupations that required bachelor's degrees, had career potential, and were related to graduates' fields of study, to change their professions than were those in other occupations.

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Appendix A—Glossary

This glossary describes the variables used in this report. The variables were taken directly from the B&B:1993/1997 Data Analysis System (DAS), an NCES software application that generates tables from the B&B:1993/1997 data. A description of the DAS software can be found in appendix B.

In the index below, the variables are organized by general topic and, within topic, listed in alphabetical order by variable name (displayed in capital letters to the right of the label). All variable names beginning with B2 are based on data collected in 1997.

Glossary Index

Graduates' Characteristics

Main activity April 1994 ..... ACT94
Main activity April 1997 ..... ACT97
Age as of 12/31/94 ..... AGE
Highest enrollment after bachelor's B2HENPRG
Bachelor's degree major ..... BAMAJOR
Panel weight for NPSAS and B&B ..... BNBPANEL
Gender ..... GENDER
Cumulative undergraduate grade point average ..... GPA
College entrance examination scores SATACTQ2

Employment Characteristics

April 1994 occupational code revised ..... AJOBOCCR
Relationship between April 1994 job and 1994 field of study ..... AJOBRELT
April 1997 occupational code revised B2AJOBR
Relationship between April 1997 job and 1994 field of study B2AJRELT
Employment status April 1994 ..... B2EM9404
Employment status April 1997 ..... B2EM9704
Occupational change ..... OCHANGE
Professional status of April 1994 job PROSTA94
Professional status of April 1997 job PROSTA97

Main activity April 1994 **ACT94**

For April 1994 and 1997, variables describing graduates' employment status (B2EM9404 and B2EM9704) were crossed with variables describing graduates' enrollment status (B2EN9404 and B2EN9704) to create variables describing graduates' main activities during April 1994 and 1997 (ACT94 and ACT97). Graduates who lacked data on either their employment or enrollment status were not assigned a valid value on these variables. Responses were coded as follows:

Primarily working
- Full-time employed, not enrolled
- Part-time employed, not enrolled
- Full-time employed, part-time enrolled

Equal parts of study and work
- Part-time employed, part-time enrolled
- Full-time employed, full-time enrolled

Primarily student
- Part-time employed, full-time enrolled
- Unemployed, full-time enrolled
- Unemployed, part-time enrolled
- Out of labor force, full-time enrolled
- Out of labor force, part-time enrolled

Unemployed
- Unemployed, not enrolled

Out of the labor force
- Out of labor force, not enrolled

Main activity April 1997 **ACT97**

See entry for Main activity April 1994 (ACT94).

Student's age as of 12/31/92 **AGE**

Indicates respondent's age on 12/31/92. Used in multivariate analysis as continuous independent variable.

April 1994 occupation code **AJOBOCCR**

For graduates who were working at both points in time, it was necessary to have a common coding scheme for their occupations in order to identify differences between their 1994 and 1997 occupations. This required that the 1994 occupation variable be recoded into the scheme that had been used for the 1997 variables. The 1994 scheme was too different from the 1997 scheme to be mapped or crosswalked onto it. Therefore, it was necessary to begin with the verbatim records of graduates' answers to the following 1994 questions:

What is/was your occupation? What type of work do/did you do at [the employer named above]? *AOCCVERB*

And what type of business or industry is/was that? *AINDVERB*

During April of this year, where were you employed?
What is/was the name of your employer? *AJOBEMPL*

The 1997 occupation variable was also recoded to ensure that its coding would be identical to the 1994 coding and to resolve some discrepancies in the original coding of the 1997 variable. Verbatim records of graduates' answers to the following similar questions were used to recode the 1997 occupation variable:

What is/was your occupation? *B2AOCCVR*

What type of business or industry is/was that? *B2AINDVR*

What was the name of your main employer? *B2AJOBEM*

The recoding process was conducted in two steps. First, researchers identified verbatim responses shared by at least five cases and wrote a computer program to code these responses into the 1997 occupation scheme automatically. Approximately one-half of both the 1994 and 1997 occupation responses were coded in this way.

The remaining cases were coded manually using the verbatim occupation response, the verbatim employer response, the verbatim industry response, and the original occupation code. The original occupation code was taken into consideration if a) the optimal code was not readily apparent without taking it into consideration and b) the original code was not implausible given the occupation, employer, and industry verbatim responses. For example, if the verbatim occupation response was truncated or indecipherable, the original occupation code was retained as long as it was not contradicted by the verbatim industry or employer responses. The original occupation code was relied upon more heavily for the 1997 responses than the 1994 because of the differences between the 1994 and 1997 code schemes. For this analysis, responses were coded as follows:

Clerical not including sales clerks	Secretaries, specialized secretary, receptionist; clerks—data entry; clerical—other
Blue collar labor	Farmers, foresters, farm/forest laborers; laborer (other than farm) mechanics, repairers, service techs; craftsmen; skilled operative; transport operatives (other than pilots)
Law enforcement, military	Protective services, criminal justice administration; military
Business, financial services	Business/financial support services; financial services professionals
Legal professionals and legal support	Legal professionals; legal support
Medical professionals	Medical practice professionals; medical licensed professionals; medical services
Teachers	Educators—K–12 teachers
Other instructors and human services personnel	Educators—instructors other than K–12; human services professionals
Engineers, scientists, lab and research assistants	Engineers, architects, software engineer; scientists, statistician professionals; research assistant/lab technicians
Computer and technical workers	Technical/professional workers—other; computer systems/related professional/technical workers; computer programmers; computer & computer equipment operators

Editors, writers, and artists	Editors, writers, reporters, public relations; performers/artists
Business owners and other managers	Managers—executive; managers—midlevel; managers—supervisory, office, other
Sales and service	Cashiers, tellers, sales clerks; personal services; cooks, chefs, bakers, cake decorators; sales/purchasing; customer service; health/recreation services

The remaining codes (unemployed—homemaker, unemployed—other, and uncodeable) were not included in the disaggregations presented in the bivariate analyses or in the multivariate analysis.

Relationship between April 1994 job and 1992–93 degree **AJOBRELT**

Indicates how closely related 1994 job was to respondent's undergraduate or graduate field of study.

Somewhat or closely related
Not at all related

April 1997 occupation code **B2AJOBR**

See description for AJOBOCCR.

Relationship between April 1997 job and degree field **B2AJRELT**

Indicates how closely related 1997 job was to respondent's undergraduate or graduate field of study. In the bivariate analyses, this variable was coded as follows:

Somewhat or closely related
Not at all related

In the multivariate analyses, all three categories of the variable (i.e., closely, somewhat, and not at all related) were used.

B2EM9404 Employment status April 1994 **B2EM9404**

Indicates the student's employment status in April 1994.

Full-time
Part-time

Employment status April 1997 **B2EM9704**

Indicates the student's employment status in April 1997.

Full-time
Part-time

Undergraduate major recoded **BAMAJOR**

Identifies a respondent's undergraduate major field of study. Majors were classified as follows:

Education	Early childhood, elementary, secondary, special, physical, other
Engineering, mathematics, science	Architecture, engineering (electrical, chemical, civil, mechanical, other), technology, mathematics, statistics, physical science, chemistry, earth science, physics, biological science (zoology, botany, biochemistry, other), biophysics, interdisciplinary (environmental studies, biopsychology, integrated/general)
Other	Computer programming, computer and information sciences, nursing, dental/medical tech, community/mental health, nurse assisting, general and other health, health/physical education/recreation (HPER), audiology, clinical health science, health/hospital administration, dietetics, journalism, communications, communication technology, American civilization, area studies, African American studies, ethnic studies, Spanish, foreign languages (non-European, European), letters (English/American literature, creative/technical writing, other), liberal studies, women's studies, philosophy, religious studies, history, design, speech/drama, film arts, music, art history/fine arts, other fine and performing arts, clinical pastoral care, protective services, social work, public administration, psychology, anthropology/archaeology, economics, geography, sociology, political science, international relations, city planning, agriculture, agricultural science, natural resources, forestry, textiles, other home economics, vocational home economics, guidance, law (paralegal, pre-law, law), library/archival science, military science, other interdisciplinary, leisure studies, basic/personal skills, industrial arts (construction, commercial art, precision production), air transportation

Panel weight for NPSAS and B&B **BNBPANEL**

Panel weight for NPSAS, B&B93/94, and B&B93/97 response. This is the panel weight for B&B:93/97, which is B0 adjusted for nonresponse at any of the follow-up surveys. Panel respondents are those who responded to all three surveys: NPSAS:93, B&B:93/94, and B&B:93/97. Therefore, the panel category is greater than 0 for only those persons who responded to all three surveys.

Highest degree program enrolled after BA **B2HENPRG**

Identifies degree type for the highest degree enrolled after bachelor's degree. The following groups were defined.

Any postsecondary enrollment
- Associate degree
- Bachelors degree
- Post-baccalaureate certificate
- Masters degree
- MBA
- Post-masters certificate
- First professional
- Doctoral degree
- Certificate or license
- Non-degree program

Any graduate enrollment
- Post-baccalaureate certificate
- Masters degree
- MBA
- Post-masters certificate
- First professional
- Doctoral degree
- Certificate or license
- Non-degree program

Student's gender **GENDER**

Respondent's gender.

- Male
- Female

Student's cumulative grade point average **GPA**

Indicates respondent's cumulative grade point average. This variable was coded as follows:

- Less than 2.75
- 2.75 - 2.99
- 3.00 - 3.49
- 3.50 or higher

Comparison of April 1994 and April 1997 occupations **OCHANGE**

Identifies whether respondents were in the same occupation in April 1997 as they had been in April 1994. Graduates whose April 1994 occupation category exactly matched the April 1997 occupation category were defined as in the "same" occupation category at the two points in time. In addition, the following occupation category combinations were defined as "same" occupation for the purposes of this variable because they are likely to represent movements within a career or occupation ladder:

Clerks—secretarial, Clerks—data entry, Clerks—other
Medical licensed professionals and medical service occupations
Medical licensed professionals and medical practice professionals
Legal support workers and legal professionals
Clerks—sales and sales/purchasing workers
Clerks—sales and customer service workers
Business/financial support service workers and financial services professionals
Business/financial support service workers and Managers—supervisory, office, and other administrative
Research assistants/lab technicians and researchers
Research assistants/lab technicians (which includes engineering assistants) and engineering and architectural professionals/engineers
Computer operators, computer programmers, and computer systems/related professional/technical workers
Computer systems/related professional/technical workers, computer programmers, and engineering and architectural professionals/engineers
Repair workers, craftsmen, skilled operatives, and transport operatives (other than pilots)

Graduates with all other combinations of occupation categories were defined as working in "different" occupation categories at the two points in time.

College entrance examination scores **SATACTQ2**

Indicates respondent's merged SAT and ACT score quartile. Responses were coded as follows:

Bottom quartile
Second quartile
Third quartile
Top quartile

Professional status of April 1994 job **PROSTA94**

Indicates the professional status of respondent's April 1994 job. Responses were grouped in following ways:

No degree needed, not much career potential
No degree needed, possible or definite career potential
Degree needed, not much career potential
Degree needed, possible or definite career potential

Professional status of April 1997 job **PROSTA97**

Indicates the professional status of respondent's April 1997 job. Responses were classified as follows:

No degree needed, not much career potential
No degree needed, possible or definite career potential
Degree needed, not much career potential
Degree needed, possible or definite career potential

Appendix B—Technical Notes and Methodology

The Baccalaureate and Beyond Longitudinal Study[8]

The data analyzed in this report came from the First and Second Follow-ups of the Baccalaureate and Beyond Longitudinal Study (B&B:93/94 and B&B:93/97), a study that tracks the experiences of a cohort of college graduates who received baccalaureate degrees during the 1992–93 academic year and were first interviewed as part of the National Postsecondary Student Aid Study (NPSAS:93). This group's experiences in the areas of academic enrollments, degree completions, employment, public service, and such other adult decisions as family formation have been followed through 1997. The data derived from this survey provide critical information about college graduates' postsecondary education outcomes, including graduate and professional program access, labor market experience, and rates of return on investment in education.

The B&B: 93/94 survey was the first follow-up interview of NPSAS:93 participants who received their bachelor's degrees between July 1992 and June 1993. Of approximately 12,500 NPSAS:93 respondents who were identified as potentially eligible for the first follow-up survey, about 1,500 were determined to be ineligible. Approximately 10,100 eligible individuals completed the 1994 interview.

The B&B:93/97 survey is the second follow-up interview of the B&B cohort. The first follow-up interview (B&B:93/94) collected information from respondents 1 year after they received the bachelor's degree; the second follow-up (B&B:93/97) collected data 4 years after they received the bachelor's degree. Data collection for B&B:93/97 took place between April and December 1997. About 11,200 individuals in the B&B cohort were determined eligible for follow-up in 1997. For the second follow-up, about 10,100 interviews were completed, yielding a response rate of 90 percent. Approximately 9,300 individuals (83 percent of the sample) responded to all three rounds of the B&B study. Referred to as "the B&B panel sample," these respondents became the base sample of the analyses presented in this report.

The NPSAS:93 sample, while representative and statistically accurate, was not a simple random sample. Instead, the survey sample was selected using a more complex three-step procedure with stratified samples and differential probabilities of selection at each level. Postsecon-

[8]The text in this section is based on excerpts from the *Baccalaureate and Beyond Longitudinal Study: 1993/97 Methodology Report* (NCES 1999–159) (Washington, DC: U.S. Department of Education, National Center for Education Statistics, 1999).

dary institutions were initially selected within geographic strata. Once institutions were organized by zip code and state, they were further stratified by control (i.e., public; private, not-for-profit; or private, for-profit) and degree offering (less-than-2-year, 2- to 3-year, 4-year nondoctorate-granting, and 4-year doctorate-granting).[9]

For more information about the NPSAS:93 survey, refer to the *Methodology Report for the National Postsecondary Student Aid Study, 1992–93* (NCES 95–211, Washington, DC: U.S. Department of Education, National Center for Education Statistics, 1995). For more information on procedures for the Baccalaureate and Beyond First Follow-up Study (B&B:93/94), consult the Baccalaureate and Beyond Longitudinal Study Methodology Report (NCES 96–149). For second follow-up, consult NCES 1999–159.

Sample weights. B&B:93/97 final weights were calculated by making a nonresponse adjustment to the baseline B&B weight calculated for B&B:93/94. This baseline B&B weight is an adjustment of the baseline NPSAS:93 weight to reflect final eligibility for B&B and to reflect the total number of bachelor's degrees awarded in 1992–93. All analyses in this report are weighted to compensate for unequal probability of selection into the B&B sample and to adjust for nonresponse. The B&B panel weight, based on respondents who participated in all three surveys, is used in the report. A complete description of the weighting methodology is available in the methodology reports cited above.

Accuracy of Estimates

The statistics in this report are estimates derived from a sample. Two broad categories of error occur in such estimates: sampling and nonsampling errors. Sampling errors occur because observations are made only on samples of students, not on entire populations. Surveys of population universes are not subject to sampling errors. Estimates based on a sample will differ somewhat from those that would have been obtained by a complete census of the relevant population using the same survey instruments, instructions, and procedures. The standard error of a statistic is a measure of the variation due to sampling; it indicates the precision of the statistic obtained in a particular sample. In addition, the standard errors for two sample statistics can be used to estimate the precision of the difference between the two statistics and to help determine whether the difference based on the sample is likely to represent a population difference. Tables B1a and B1b present standard errors for figures 2 and 4 of this report. Additional standard errors

[9]The NPSAS universe excludes institutions offering only correspondence courses, institutions enrolling only their own employees, and U.S. service academies. For this B&B cohort, institutions were further stratified in NPSAS by the number of degrees in education they had awarded in the past.

for estimates provided in this report can be obtained from the B&B:93/97 Data Analysis System (DAS).

Table B1a—Standard errors for Figures 2 and 4: Percentage distribution of employed 1992–93 bachelor's degree recipients according to occupation, by employment status: April 1994

	Clerical occupations	Blue collar occupations	Law enforcement occupations, military	Business support, financial services occupations	Legal professionals and legal support occupations	Health occupations
Full-time	0.34	0.31	0.25	0.69	0.15	0.52
Part-time	0.95	0.83	0.39	0.71	0.23	0.77

NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

Table B1b—Standard errors for Figures 2 and 4: Percentage distribution of employed 1992–93 bachelor's degree recipients according to occupation, by employment status: April 1994

	K–12 teachers	Other instructors and human services occupations	Engineers, scientists, lab and research assistants	Computer and technical occupations	Editors, writers, artists	Business owners and other managers	Sales and service occupations
Full-time	0.47	0.60	0.51	0.35	0.30	0.53	0.66
Part-time	1.14	1.12	0.81	0.56	0.59	0.79	1.56

NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1992–93 Baccalaureate and Beyond Longitudinal Study, Second Follow-up (B&B:93/97), Data Analysis System.

Nonsampling errors occur not only in sample surveys but also in complete censuses of entire populations. Nonsampling errors can be attributed to a number of sources: inability to obtain complete information about all students in all institutions in the sample (some students or institutions refused to participate, or students participated but answered only certain items); ambiguous definitions; differences in interpreting questions; inability or unwillingness to give correct information; mistakes in recording or coding data; and other errors of collecting, processing, sampling, and imputing missing data. Although nonsampling errors due to questionnaire and item nonresponse can be reduced somewhat by the adjustment of sample weights and imputation procedures, correcting nonsampling errors or gauging the effects of these errors is usually difficult.

Data Analysis System

The estimates presented in this report were produced using the B&B:93/97 Data Analysis System (DAS). The DAS software makes it possible for users to specify and generate their own tables from the B&B:93/97 data. With the DAS, users can replicate or expand upon the tables presented in this report. In addition to the table estimates, the DAS calculates proper standard errors[10] and weighted sample sizes for these estimates. For example, table B1 contains estimated standard errors that correspond to the estimates presented in Figures 2 and 4 and that were generated by the B&B:93/97 DAS. If the number of valid cases is too small to produce a reliable estimate (fewer than 30 cases), the DAS prints the message "low N" instead of the estimate.

In addition to tables, the DAS will also produce a correlation matrix of selected variables to be used for linear regression models. Included in the output with the correlation matrix are the design effects (DEFTs) for each variable in the matrix. Since statistical procedures generally compute standard errors based on an assumption of simple random sampling, the standard errors must be adjusted with the design effects to take into account B&B's complex sample design. (See discussion under "Statistical Procedures" below for the adjustment procedure.)

For more information about the B&B:93/97 and other Data Analysis Systems, consult the NCES DAS website (nces.ed.gov/das) or contact:

Aurora D'Amico
National Center for Education Statistics
1990 K Street, NW
Room 8115
Washington, DC 20006
(202) 502-7334
Internet address: Aurora_D'Amico@ed.gov

Statistical Procedures

Differences Between Means

The descriptive comparisons were tested in this report using Student's *t* statistic. Differences between estimates are tested against the probability of a Type I error,[11] or significance level. The significance levels were determined by calculating the Student's *t* values for the dif-

[10]The B&B sample is not a simple random sample, and therefore simple random sample techniques for estimating sampling error cannot be applied to these data. The DAS takes into account the complexity of the sampling procedures and calculates standard errors appropriate for such samples. The method for computing sampling errors used by the DAS involves approximating the estimator by the linear terms of a Taylor series expansion. The procedure is typically referred to as the Taylor series method.

[11]A Type I error occurs when one concludes that a difference observed in a sample reflects a true difference in the population from which the sample was drawn, when no such difference is present.

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ferences between each pair of means or proportions and comparing these with published tables of significance levels for two-tailed hypothesis testing.

Student's *t* values may be computed to test the difference between estimates with the following formula:

$$t = \frac{E_1 - E_2}{\sqrt{se_1^2 + se_2^2}} \quad (1)$$

where E_1 and E_2 are the estimates to be compared and se_1 and se_2 are their corresponding standard errors. This formula is valid only for independent estimates. When estimates are not independent, a covariance term must be added to the formula:

$$\frac{E_1 - E_2}{\sqrt{se_1^2 + se_2^2 - 2(r)se_1\ se_2}} \quad (2)$$

where *r* is the correlation between the two estimates.[12] This formula is used when comparing two percentages from a distribution that adds to 100. If the comparison is between the mean of a subgroup and the mean of the total group, which is the primary comparison in this report, the following formula is used:

$$\frac{E_{sub} - E_{tot}}{\sqrt{se_{sub}^2 + se_{tot}^2 - 2p\,se_{sub}^2}} \quad (3)$$

where *p* is the proportion of the total group contained in the subgroup.[13] The estimates, standard errors, and correlations can all be obtained from the DAS.

There are hazards in reporting statistical tests for each comparison. First, comparisons based on large *t* statistics may appear to merit special attention. This can be misleading since the magnitude of the *t* statistic is related not only to the observed differences in means or percentages but also to the number of students in the specific categories used for comparison. Hence, a small difference compared across a large number of students would produce a large *t* statistic.

A second hazard in reporting statistical tests for each comparison occurs when making multiple comparisons among categories of an independent variable. For example, when making

[12]U.S. Department of Education, National Center for Education Statistics, A Note from the Chief Statistician, no. 2, 1993.
[13]Ibid.

paired comparisons among different levels of income, the probability of a Type I error for these comparisons taken as a group is larger than the probability for a single comparison. When more than one difference between groups of related characteristics or "families" are tested for statistical significance, one must apply a standard that assures a level of significance for all of those comparisons taken together.

Comparisons were made in this report only when $p \leq .05/k$ for a particular pairwise comparison, where that comparison was one of k tests within a family. This guarantees both that the individual comparison would have $p \leq .05$ and that for k comparisons within a family of possible comparisons, the significance level for all the comparisons will sum to $p \leq .05$.[14]

For example, in a comparison of males and females, only one comparison is possible (males versus females). In this family, $k=1$, and the comparison can be evaluated without adjusting the significance level. When students are divided into five racial/ethnic groups and all possible comparisons are made, then $k=10$ and the significance level of each test must be $p \leq .05/10$, or $p \leq .005$. The formula for calculating family size (k) is as follows:

$$k = \frac{j(j-1)}{2} \tag{4}$$

where j is the number of categories for the variable being tested. In the case of race/ethnicity, there are five racial/ethnic groups (American Indian/Alaskan Native; Asian/Pacific Islander; black, non-Hispanic; Hispanic; and white, non-Hispanic), so substituting 5 for j in equation 4,

$$k = \frac{5(5-1)}{2} = 10$$

Linear Trends

While most descriptive comparisons in this report were tested using Student's t statistic, some comparisons among categories of an ordered variable with three or more levels involved a test for a linear trend across all categories, rather than a series of tests between pairs of categories. In this report, when differences among percentages were examined relative to a variable with ordered categories, Analysis of Variance (ANOVA) was used to test for a linear relationship between the two variables. To do this, ANOVA models included orthogonal linear contrasts corresponding to successive levels of the independent variable. The squares of the Taylorized

[14]The standard that $p \leq .05/k$ for each comparison is more stringent than the criterion that the significance level of the comparisons should sum to $p \leq .05$. For tables showing the t statistic required to ensure that $p \leq .05/k$ for a particular family size and degrees of freedom, see Olive Jean Dunn, "Multiple Comparisons Among Means," *Journal of the American Statistical Association* 56 (1961): 52–64.

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standard errors (that is, standard errors that were calculated by the Taylor series method), the variance between the means, and the unweighted sample sizes were used to partition total sum of squares into within- and between-group sums of squares. These were used to create mean squares for the within- and between-group variance components and their corresponding F statistics, which were then compared with published values of F for a significance level of .05.[15] Significant values of both the overall F and the F associated with the linear contrast term were required as evidence of a linear relationship between the two variables. Means and Taylorized standard errors were calculated by the DAS. Unweighted sample sizes are not available from the DAS and were provided by NCES.

Adjustment of Means to Control for Background Variation

Tabular results are limited by sample size when attempting to control for additional factors that may account for the variation observed between two variables. For example, when examining percentages of graduates who worked in the same occupations in April 1994 and April 1997, it is impossible to know to what extent the observed variation is due to the April 1994 occupation and to what extent it is due to differences in graduates' perceptions of their occupations' relationships to their fields of study or professional status. However, if a nested table were produced showing the percentage who worked in the same occupation within occupations within relationship to degree fields within perceptions of professional status, the cell sizes would be too small to identify the patterns. When the sample size becomes too small to support controls for covariation, one must use other methods to take such covariation into account.

To overcome this difficulty, multiple linear regression was used to obtain means that were adjusted for covariation among a list of control variables.[16] Adjusted means for subgroups were obtained by regressing the dependent variable on a set of descriptive variables such as gender, age, employment status, occupation, relationship of occupation to degree fields, perceived professional status of occupation, and so on. Substituting ones or zeros for the subgroup characteristic(s) of interest and the mean proportions for the other variables results in an estimate of the adjusted proportion for the specified subgroup, holding the other variables in the equation constant. For example, consider a hypothetical case in which two variables, age and gender, are used to describe an outcome, Y (such as percentage of graduates working the same occupation in both April 1994 and April 1997). The variables age and gender are recoded into a dummy variable representing age, A, and a dummy variable representing gender, G:

---

[15]More information about ANOVA and significance testing using the F statistic can be found in any standard textbook on statistical methods in the social and behavioral sciences.

[16]For more information about weighted least squares regression, see Michael S. Lewis-Beck, *Applied Regression: An Introduction*, Vol. 22 (Beverly Hills, CA: Sage Publications, Inc., 1980); William D. Berry and Stanley Feldman, *Multiple Regression in Practice*, Vol. 50 (Beverly Hills, CA: Sage Publications, Inc., 1987).

Age	*A*
24 years or older	1
Less than 24 years old	0
and	
Gender	*G*
Female	1
Male	0

The following regression equation is then estimated from the correlation matrix output from the DAS:

$$\hat{Y} = a + b_1 A + b_2 G \tag{5}$$

To estimate the adjusted mean for any subgroup evaluated at the mean of all other variables, one substitutes the appropriate values for that subgroup's dummy variables (1 or 0) and the mean for the dummy variable(s) representing all other subgroups. For example, suppose *Y* represents the proportion of graduates who worked in the same occupation in April 1994 and April 1997, which is being described by age (*A*) and gender (*G*), coded as shown above. The unadjusted mean values of these two variables are as follows:

Variable	Mean
A	0.355
G	0.521

Next, suppose the regression equation results are as follows:

$$\hat{Y} = 0.15 + 0.17A + 0.01G \tag{6}$$

To estimate the adjusted value for older graduates, one substitutes the appropriate parameter estimates and variable values into equation 6.

Variable	Parameter	Value
a	0.15	—
A	0.17	1.000
G	0.01	0.521

This results in the following equation:

$$\hat{Y} = 0.15 + (0.17)(1) + (0.01)(0.521) = 0.325$$

In this case, the adjusted mean for older graduates is 0.325 and represents the expected outcome for older graduates who resemble the average graduate across the other variables (in this example, gender). In other words, the adjusted percentage of graduates who worked in the same

occupation at both points in time, controlling for age and gender, is 32.5 percent (0.325 x 100 for conversion to a percentage).

It is relatively straightforward to produce a multivariate model using the DAS, since one of the DAS output options is a correlation matrix, computed using pairwise missing values. In regression analysis, there are several common approaches to the problem of missing data. The two simplest are pairwise deletion of missing data and listwise deletion of missing data. In pairwise deletion, each correlation is calculated using all of the cases for the two relevant variables. For example, suppose you have a regression analysis that uses variables X1, X2, and X3. The regression is based on the correlation matrix between X1, X2, and X3. In pairwise deletion the correlation between X1 and X2 is based on the nonmissing cases for X1 and X2. Cases missing on either X1 or X2 would be excluded from the calculation of the correlation. In listwise deletion the correlation between X1 and X2 would be based on the nonmissing values for X1, X2, and X3. That is, all of the cases with missing data on any of the three variables would be excluded from the analysis.[17]

The correlation matrix can be used by most statistical software packages as the input data for least squares regression. That is the approach used for this report, with an additional adjustment to incorporate the complex sample design into the statistical significance tests of the parameter estimates (described below). For tabular presentation, parameter estimates and standard errors were multiplied by 100 to match the scale used for reporting unadjusted and adjusted percentages.

Most statistical software packages assume simple random sampling when computing standard errors of parameter estimates. Because of the complex sampling design used for the NPSAS survey, this assumption is incorrect. A better approximation of their standard errors is to multiply each standard error by the design effect associated with the dependent variable (DEFT),[18] where the DEFT is the ratio of the true standard error to the standard error computed under the assumption of simple random sampling. It is calculated by the DAS and produced with the correlation matrix.

[17]Although the DAS simplifies the process of making regression models, it also limits the range of models. Analysts who wish to use an approach other than pairwise treatment of missing values or to estimate probit/logit models (which are the most appropriate for models with categorical dependent variables) can apply for a restricted data license from NCES. See John H. Aldrich and Forrest D. Nelson, Linear Probability, Logit and Probit Models (*Quantitative Applications in Social Sciences*, Vol. 45) (Beverly Hills, CA: Sage, 1984).

[18]The adjustment procedure and its limitations are described in C.J. Skinner, D. Holt, and T.M.F. Smith, eds., *Analysis of Complex Surveys* (New York: John Wiley & Sons, 1989).

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